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A STUDY OF THE OPERATION OF SEWAGE PONDS IN THE PROVINCE OF ALBERTA

Division of Sanitary Engineering
Department of Public Health
Government of Alberta
Edmonton, Alberta
March, 1965

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A STUDY OF THE OPERATION

OF

SEWAGE PONDS

IN THE

PROVINCE OF ALBERTA

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Division of Sanitary Engineering
Department of Public Health
Government of Alberta
Edmonton, Alberta

March, 1965

FOREWORD

This report contains the results and conclusions for a study of the operation of sewage ponds in Alberta during the period from September 1961 to July 1964 and is consecutive to the report of September 1961 which covered the period of May 1958 to September 1961.

The first study was designed to evaluate the functioning of the sewage ponds in use at that time during both the winter and summer seasons. The ponds selected for this study were mainly of the 'Long Detention - Single Cell' type with a detention capacity of about three months to one year, however one 'Short Detention or Anaerobic Pond' as well as one system with three 'Long Detention Ponds in Series' were also studied. The results indicated that significant B.O.D. and suspended solids removal efficiencies could be achieved in the anaerobic ponds during both winter and summer seasons, and that 'Long Detention Ponds' constructed as separate units operated in series were markedly superior to the single cell type. Accordingly the recommended design for sewage ponds was changed to include both 'Short and Long' Detention Ponds with the basic design as four - 4 day - 10 foot deep short detention ponds and two - 3 or 6 months - 5 foot deep long detention ponds.

This second project was designed to critically observe the operations of systems using this revised design and evaluate the efficiency and reliability of treatment, operating factors and the suitability of the design loading. A total of eleven pond systems were studied and two systems used in the first study were checked for comparative purposes. All of the analytical results obtained are tabulated and major items summarized and trends indicated on graphs.

This study was made with the kind permission of the Honourable J. Donovan Ross, M.D., Minister of Health, Government of Alberta and was sponsored financially by the Federal Research Grants Program of the Department of National Health and Welfare as Project Number 608-7-16.

H. L. Hogge,

H. L. Hogge, Director,

Division of Sanitary Engineering.

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OBJECTIVES

This report presents a summary and interpretation of all data gathered between the period of September 1961 and July 1964.

The objectives of the study were to evaluate a number of short and long detention sewage ponds as to their use and performance, and to check the design recommendations which were made by the Alberta Department of Public Health in 1961.

The plan of investigation included the following:

1) determine the sewage treatment efficiency of the ponds under all seasons of the year, particularly summer and winter.
2) consider the advantages of the various designs.
3) determine the sludge accumulation rates for short detention ponds.
4) determine the characteristics of sludge in short detention ponds.
5) determine thermal conditions in the short detention ponds during the winter.
6) consider the effect of industrial wastes on municipal owned sewage ponds.

SUMMARY

This report summarizes and evaluates observations and chemical analyses of sewage ponds under winter, spring, summer and fall conditions since the fall of 1961. Sludge and temperature surveys were conducted to determine sludge accumulation rates, sludge characteristics, and thermal conditions in short detention ponds.

Ponds varying in design, use, and size were selected and studied for the project.

A few significant findings during the period of study are given below:

A. Short Detention Ponds

(1) All ponds were anaerobic throughout the year with the exception of two ponds at Drumheller which turned aerobic in the late summer.
(2) Systems with multi-cell short detention ponds operating in series provided winter treatment ranging from 45.9% B.O.D. reduction at Three Hills to 63.4% at Red Deer. The summer performance of this type of system varied from 73.6% B.O.D. reduction at Red Deer to 91.0% at Drumheller. However two of the four ponds at Drumheller turn aerobic in the summer giving the extremely high efficiency.
(3) Systems with multi-cell short detention ponds showed a large portion of the B.O.D. and suspended solids were removed in the first cell with the exception of the system at Wetaskiwin. Generally the additional treatment provided by each successive pond in system decreased with detention time.
(4) The loading in terms of B.O.D. is not always a criterion as far as odor productions are concerned. For example, consider the following five systems:
    a) Innisfail - load 8.50 lb/1000 $ft.^3$/day - no odor problems
    b) Red Deer - load 10.8 lb/1000 $ft.^3$/day - no odor problems
    c) Medicine Hat - load 8.96 lb/1000 $ft.^3$/day - odor problems
    d) Three Hills - load 10.1 lb/1000 $ft.^3$/day - odor problems
    e) Stony Plain - load 17.7 lb/1000 $ft.^3$/day - no odor problems

Industrial wastes such as dairy wastes and meat packing wastes had caused the odor problem in the above ponds.

(5) Although a high intensity odor problem existed in several ponds a fair degree of treatment was obtained. For example, the treatment at Medicine Hat was 72.4% B.O.D. reduction through four ponds operated in series and 96.5% B.O.D. reduction for four ponds operating in parallel-series during the high odor periods.
(6) Temperature surveys on short detention ponds indicated that submerged raw sewage inlets provided constant thermal conditions during the winter. On the other hand, surface inlets produced temperature stratifications in the pond. The warmer and lighter sewage remained near the surface of the pond.
(7) Chemical characteristics for short detention ponds as observed during the studies were:
    a) pH
    No significant pond to pond variations in the multi-cell short detention ponds occurred throughout the year. With the exception of the two short detention ponds at Evansburg and a

few readings at other systems, the pH remained above 7.0 throughout the year. The general range was usually 7.0 to 8.0.

b) Ammonia-Nitrogen
In multi-cell short detention ponds no significant pond to pond variations were obtained throughout the year. In a large number of ponds the maximum values occurred during the winter and minimas during the summer.

c) Odors
Generally the threshold odor number of the liquid for normal operating systems decreased with each successive pond.

d) Total Solids
No significant pond to pond variations were obtained in a multi-cell short detention pond system throughout the year.

e) Dissolved Oxygen
With the exception of the last two ponds on the Drumheller system dissolved oxygen was not detectable in the short detention ponds that were studied.

f) Detergents
No significant reduction in detergent concentrations were obtained throughout the year.

(8) Sludge analyses at Red Deer, Camrose, Stettler and Medicine Hat showed the following characteristics:

a) All sludge samples had an acidic pH with the exception of one sample. The range was from 4.6 to 7.1 with the low readings occurring near the raw sewage inlet.
b) Total solids ranged from 5.5% to 27.9%.
c) Volatile matters ranged from 12.9% to 93.1% of dry solids. The low readings were obtained from samples farthest away from the inlet, and in some cases the sample may have been a combination of sludge and natural soil.
d) Odors ranged from very putrid to tarry. A few samples, particularly those near the raw sewage inlet, had a very putrid odor which made analyses impossible.

(9) Sludge accumulation rates varied from 2.38 cubic feet/1000 persons/day to 13.5 cubic feet/1000 persons/day occuring at Red Deer pond number two and pone one, respectively. The figures are based on actual population and the volume of sludge in the ponds. However, based on the suspended solids removed in the ponds and assuming a moisture content of 10%, the sludge accumulation would have been 18.6 cubic feet/1000 persons/day for Red Deer pond number one and 19.6 cubic feet/1000 persons/day for Red Deer pond number two.

B. Long Detention Ponds

(1) Long detention ponds became anaerobic, i.e. no dissolved oxygen, shortly after ice cover formed. However, several ponds which had a continuous overflow during the winter or a liquid depth of several feet when ice formed had dissolved oxygen present till the middle of winter.

(2) The single long detention pond at Lacombe produced a B.O.D. reduction of 92.0% in summer, but a relatively poor treatment in winter of only 30.1%.

(3) Long detention ponds constructed as separate units, and operating in series produced a slightly better treatment than the single pond system during the winter. e.g. Drayton Valley had a B.O.D. reduction of 48.8% for two ponds in series during the winter of 1961-62 and 53.5% for a three pond system in the winter of 1962-63 and 1963-64.

(4) Of the systems studied the southeast system at Wetaskiwin had serious odor problems during the spring and summer of 1963. The B.O.D. load in the initial pond of three in series was 248 lb/acre/day. The heavy B.O.D. load was caused by dairy wastes from a milk condensery plant.

(5) Chemical characteristics for long detention ponds as observed during the studies were:

a) pH
The pH in all the ponds were above 7.0 throughout the year. During the summer, algae raised the pH of the pond liquid to values as high as 9.0.

b) Ammonia-Nitrogen
The ammonia-nitrogen content reached their maximum values during the winter and the minimas in the summer with concentrations as low as 5 ppm.

c) Odors
Generally the threshold odor number of the liquid for normal operating systems decreased with each successive pond.

d) Dissolved Oxygen
Ponds with detention periods of more than one month had dissolved oxygen present in the summer with values as high as 30 ppm while in the winter it was not detectable.

e) Detergents
No significant reduction in detergent concentrations were obtained throughout the year.

C. Combined Systems

(1) Combined systems consisting of short and long detention ponds provided treatment ranging from 82.5% B.O.D. reduction at Camrose to 93.0% at Evansburg during the summer. However, the high degree of treatment at Evansburg was associated with a very serious odor problem. The odors were due to an extremely high B.O.D. load caused by dairy wastes. In the short detention pond the loading was high as 58 lb/1000 $ft.^3$/day or 25,300 lb/acre/day. During the winter the treatment range was 62.5% B.O.D. reduction at Innisfail to 96.0% at Evansburg.

(2) Other characteristics of the ponds have been discussed under short and long detention ponds.

SEWAGE STABILIZATION PONDS IN ALBERTA

Introduction

The use of stabilization ponds or sewage lagoons to treat sewage has become increasingly popular by cities, towns, villages, and institutions in the Province of Alberta. Up to January 1964, 158 of the 219 communities served by a sewerage system used some type of ponding for their sewage treatment.

A number of factors could be attributed to the wide use of sewage ponds such as:

(1) Low Initial cost
(2) Low operating cost
(3) High degree of treatment
(4) Minimum of nuisance or offensive odor
(5) Ease of operation

There are five types of stabilization ponds used in Alberta, and the numbers of each installation in use is given below:-

(1) Long detention; single cell - 73
(2) Combination of short and long detention ponds - 41
(3) Long detention; multicell - 29
(4) Short detention; multicell - 9
(5) Short detention; single cell - 6

The type of system to be used is usually governed by the location of the community as to river, a well defined drainage course or a slough, and storage requirements.

Program of Study

(1) To determine the treatment efficiency and loading of the various systems, the following were selected for this purpose -

Location	Type of Pond
1) Camrose	Combination - 4 short and 2 long detention ponds
2) Drayton Valley	3 long detention ponds
3) Drumheller	4 short detention ponds
4) Evansburg	Combination - 2 short and 2 long detention ponds
5) Innisfail	Combination - 4 short and 2 long detention ponds
6) Lacombe	1 long detention pond
7) Medicine Hat	Combination - 4 short and 1 long detention ponds
8) Red Deer	5 short detention ponds
9) Stettler	Combination - 4 short and 2 long detention ponds
10) Stony Plain	Combination - 3 short and 1 long detention ponds
11) Three Hills	4 short detention ponds
12) Wetaskiwin -2 systems	a) Northeast: Combination - 3 short and 2 long detention ponds b) Southeast: 4 long detention ponds

The general layout and information of each pond system is contained in Appendix A.

(2) Physical and Chemical Observations

The physical and chemical observations made throughout the study were:

(A) Physical:
Raw Sewage flows
Wind velocity
Pond temperature
Light intensity
Ice thickness
Odors in vicinity of the ponds.

(B) Chemical:
pH
Dissolved oxygen
Odor of liquid
Biochemical oxygen demand
Ammonia-nitrogen
Total solids - Total and volatile
Suspended solids - Total and volatile
Alkalinity

In the earlier part of the study the following chemical analyses were made in addition to the ones mentioned above:

Nitrogen - Total
- Nitrite
- Nitrate
Chlorides
Sulfates
Phosphates
Detergents

(3) Sampling and Sewage Flows

Except for five sampling dates at Red Deer, all chemical analyses of pond liquids have been based on grab samples obtained at the effluent points. The five samples at Red Deer were either 18-hour or 24-hour composites, and the sampling intervals are given on the chemical analyses sheets, Appendix A. For grab samples the time of sampling was noted for each pond. Sampling was done at the same area for each pond, generally at the overflows, unless ice conditions, changes in pond operation or some other factors necessitated a change in the sampling location.

Raw sewage results are based on composite samples and the duration of each sampling, e.g. hourly portions for 12 hours, are indicated on the chemical analyses data sheets. The volume of each portion of a composite sample was proportioned to the sewage flow at the time of collection.

All chemical tests were carried out as outlined in the procedures of "Standard Methods" 11th Edition.

Sewage flows were measured by one of two methods: (1) Recording ammeter - This was employed at systems with lift stations. By measuring the time of operation of a pump, and knowing the pumping rate or the wet well capacity, the flow can be computed, or (2) Rectangular weir with a flow recorder - This was used at gravity sewerage systems. The weir was placed in a manhole near the pond inlet or in an overflow channel between the ponds for short detention pond systems.

Table 1

The characteristics of the raw sewage and other pertinent data of each location are tabulated below:

Location		Population	Sewage Flow - G.P.C.D.	Water Consumption G.P.C.D.	BOD - PPM	BOD Contribution lb/capita/day	Suspended Solids PPM	Suspended Solids lb/capita/day
Camrose		7700	61.8	60.0	369	0.228	384	0.237
Drayton Valley		3550	67.5	64.6	213	0.144	188	0.127
Drumheller		3156	68.9	60.4	281	0.194	213	0.147 *
Evansburg		500	102.0	80.0	1216	1.24	377	0.384
Innisfail		2600	67.6	61.5	262	0.178	391	0.264
Lacombe		3140	43.7	47.8	312	0.136	251	0.110
Medicine Hat	1961-62	24600	114.0		203	0.232	170	0.194
	1962-64	25109	119.0	182.0	287	0.342	239	0.286
Red Deer	1961-63	20000	46.0		436	0.20	362	0.166
	1963-64	23000	66.5	65.2	353	0.234	327	0.218
Stettler		3808	62.5	42.8	311	0.194	263	0.168
Stony Plain		1463	41.0	47.6	330	0.135	373	0.153 *

Table 1 (con't)

Location	Population	Sewage Flow G.P.C.D.	Water Consumption G.P.C.D.	BOD - PPM	BOD Contribution lb/capita/day	Suspended Solids PPM	Suspended Solids lb/capita/day
Three Hills	1400 +1400 from Bible Institute	41.0	40.0	362	0.148	310	0.127
Wetaskiwin - N.E.	4500	59.5		266	0.158	352	0.210
- S.E.	1100	87.4		722	0.630	358	0.312

* Serves Domestic Sewage Only.

SUMMARY ON THE OPERATION OF SHORT DETENTION PONDS

(1) General:

Short detention ponds are sewage treatment units having detention periods up to ten days, and have depths varying from 5 to 15 feet. These ponds primarily reduce the biochemical oxygen demand and suspended solids of the raw sewage with the degree of treatment equivalent to primary. The sewage is treated by means of anaerobic decomposition, i.e. no oxygen is utilized in the stabilization process. When a number of short detention ponds are operated in series, a large quantity of the suspended solids settle in the first cell, and hence result in sludge accumulation. This sludge undergoes digestion carried out by anaerobic organisms.

It was determined that by continuously passing raw sewage through the ponds, and having solids accumulate and digest thus providing anaerobic conditions, a high organic (B.O.D.) load can be treated without creating serious problems.

(2) B.O.D. Load:

Of the systems containing a series of short detention ponds, only one provided no B.O.D. removal in the first cell. This one exception was in the northeast system at Wetaskiwin where a negative reduction in B.O.D. was obtained. In other systems the B.O.D. reduction in the first cell varied from 19.1% at Innisfail to 68.4% at Medicine Hat in the winter while summer ranges were 31.7% at Innisfail to 61.4% at Drumheller.

At Wetaskiwin the depth of the pond from the ground surface (fourteen feet to the liquid surface) may be hindering wind action thus providing poor mixing within the pond, and subsequently resulting in extreme septic conditions. The B.O.D. load was 9.08 lb/1000 ft.^{3}/day or 1,980 lb/acre/day which is a smaller organic load than applied to most anaerobic sewage ponds in the province.

B.O.D. loading for ponds ten feet deep varied from 3.29 lb/1000 ft.^{3}/day (1,435 lb/acre/day) at Camrose to 58 lb/1000 ft.^{3}/day (25,300 lb/acre/day) at Evansburg. For ponds having depths less than ten feet, the B.O.D. load ranged from 2.61 lb/1000 ft.^{3}/day (798 lb/acre/day) at Drumheller to 17.7 lb/1000 ft.^{3}/day (4,630 lb/acre/day) at Stony Plain. The results indicate the loading per volume of water in the pond to be significant as compared to the usual units of lb/acre/day.

The overall treatment provided by ponds operating in series varied considerably. In the winter the range was 12.0% at Wetaskiwin to 82.6% B.O.D. reduction at Medicine Hat. The summer variation was 43.9% B.O.D. reduction at Innisfail to 91.0% at Drumheller. In most systems the additional treatment provided by each successive pond decreased with detentiontime.

At Drumheller the last two ponds of the four in series became aerobic during the summer, and hence resulted in the high degree of treatment. A good algae growth was observed in the ponds, thus providing the required oxygen for aerobic conditions.

The secondary ponds at Camrose had some algae growth (no counts available) during the summer, but no dissolved oxygen was indicated.

Observations on other systems showed no significant growth of algae during the summer and hence the ponds were in an anaerobic condition.

The B.O.D. performance based on average yearly, winter and summer results have been tabulated on table 16, page B-1 to table 18, page B-5.

(3) Chemical Analyses:

The removal of suspended solids in short detention ponds have been based on winter analysis only. The per cent suspended solids removed by a series of ponds varied from 64.4% at Evansburg to 91.0% at Camrose. In all the systems, except at Three Hills, more than 55% of the suspended solids were removed in the first pond. The amount of suspended solids removed by each successive pond in a system generally decreased with detention time. The suspended solids removed in short detention ponds have been tabulated on table 19 pages B-6 and B-7.

Suspended solid analysis indicates that sludge accumulation would only be significant in the first cell of a system. The problem of sludge accumulation in anaerobic ponds have been discussed under a separate section. The total per cent removed are given in Table 19.

No significant pond to pond variations were established on the other chemical analyses that were carried out.

The pH in the short detentions, except at Evansburg, and a few readings on the other systems, were above 7.0 throughout the year.

(4) Odors:

Of the short detention ponds studied three systems, Evansburg, Medicine Hat, and Three Hills, received complaints of odors from the public. However, at all other ponds, odors of varying intensity were only detectable at 1,000 feet or less from the ponds throughout the year.

The odor nuisance arising from the ponds at Evansburg was due to an extremely heavy organic load. Dairy wastes, particularly skim milk, "dumped" into the ponds are a major cause of the overloading. Figures on the volume of waste discharged into the system were not available, although the average flow for a two-day period to the lagoon was 51,000 gal./day or 102 gal./capita/day. The sewage flow seems exceptionally high for a community of 500, and would indicate a large volume of dairy wastes was "dumped" into the system during the recording of the flow. Analysis of the raw sewage for a three-day period gave an average B.O.D. of 1,216 ppm, and acidic pH ranging from 6.15 to 6.7. The raw sewage was of poor quality before it entered the ponds. Hydrated lime was boardcast at the ponds in an attempt to raise the pH to proper anaerobic conditions. Although there was some success in correcting the pH of the liquid, the odor nuisance still existed. See Evansburg, Appendix A for a detail report.

At Medicine Hat the source creating the odor nuisance was not as easily detectable. Before the major industrial contributor, a meat packing plant, went into operation the maximum B.O.D. loading was 5.94 lb/1000 ft.^{3}/day or 2,590 lb/acre/day. During this period no serious odor problems developed and a high degree of treatment was achieved. The B.O.D. loading was increased to 8.96 lb/1000 ft.^{3}/day (3,910 lb/acre/day)after the meat

packing plant went into operation. The following spring, odors developed from the ponds and remained throughout the summer. Chemicals were used in efforts to relieve the odor nuisance, but were unsuccessful. In 1964 the meat packing plant suspended operations during the spring and summer. This reduced the B.O.D. load to 3.84 lb/1000 ft.^{3}/day or 1,680 lb/acre/day on the initial pond. Although there were no long continuous periods of odorous conditions, there were however, the odd short period of high odor intensity.

The maximum loading at Three Hills was 10.1 lb/1000 ft.^{3}/day or 4,400 lb/acre/day. Odors have been dectected by residents as far as one mile from the ponds. The odors do not exist for any prolonged period of time and generally are detectable in town when the wind is from the direction of the ponds. A majority of the complaints were received in the evenings.

(5) Physical Aspects:

The physical set-up of anaerobic ponds could affect the treatment process to some degree. A few highlights on the construction of the ponds were noted and comments are give below.

All inlet and outlet structures on short detention ponds should be submerged and extended only a few feet from the berms. For inlets, particularly those handling raw sewage, should be submerged 1/3 to 2/3 of the depth below the water surface. This will prevent temperature stratification during the winter, and hence result in a longer detention time. Furthermore the warm temperature of the raw sewage near the bottom of the pond will assist in the sludge digestion process. The preference of the submerged effluent structure is to contain all floating materials in the pond.

The use of concrete flumes between ponds should be avoided. Frost heaving and the freezing of blown snow have been a problem with these concrete structures. The use of piping between ponds is preferred, and does not create any serious problems such as those encountered by the concrete structures.

Floating materials, such as sludge, scum, grease, and other debris are quite noticeable in most anaerobic ponds, particularly in the initial ponds. Some odors may develop from this condition.

The first pond in each system, except at Drumheller and Evansburg, had no ice cover throughout the winter.

SLUDGE DEPOSITS AND TEMPERATURES IN SHORT DETENTION PONDS

(1) General:

Short detention ponds or anaerobic ponds are designed to function as sedimentation and digestion units, as well as B.O.D. removal systems. When a number of ponds are operated in series raw sludge is deposited and digested in one pond, hence a sludge build-up occurs in the pond.

Sludge can be defined as accumulated settled solids deposited from domestic or industrial wastes combined with varying amounts of water, and having a specific gravity of about 1.2. Sludge digestion or treatment is the reduction in volume and the decomposition of organic matter to stable organic and inorganic compounds, and is carried out in the absence of free oxygen by anaerobic organisms.

To determine the rate of sludge accumulation and its characteristics in anaerobic ponds several sludge surveys were conducted at the following locations:

(1) Red Deer
(2) Medicine Hat
(3) Camrose
(4) Stettler

The surveys at Red Deer were done during the in-use and by-pass periods.

Several temperature surveys were conducted at Red Deer and Medicine Hat. These temperature readings were taken to determine thermal characteristics in short detention cells during the winter.

(2) Methods Used:

Sludge was measured using the following procedures:

(a) A grid system was staked out, and depth measurements were taken at various locations from a boat.

(b) Measurements from the water surface to the top of the sludge surface were determined by using a "depth stick".

(c) The depth of the pond was obtained either from design plans or by actual measurements.

(d) Sludge depth, then is (c) - (b).

A special sampling device was designed to obtain sludge near the bottom of the pond. In some cases this was impossible. At the time of sampling the pH, temperature, and appearance of the sludge were recorded while all other analyses were done in the laboratory.

At Red Deer, on February 13, 1963, a temperature survey was conducted on pond one, and pond two. A sampling gadget was devised to obtain samples at different depths and at several locations. All temperatures were recorded immediately after the samples were collected.

On February 5, 1964, at Red Deer pond two, a long distance temperature indicator was installed about 75 feet from the raw sewage inlet, and at the bottom of the pond (about 1.5 feet of sludge). Unfortunately due to blizzard conditions all temperature readings for the month of February were lost. However, a record of periodic temperatures taken between March and July 1964 were available.

A temperature survey on pond one at Medicine Hat was conducted using a long distance temperature recorder. The probe of the temperature recorder was dragged behind a boat at different depths.

(3) Presentation of Data:

All results of temperature and sludge surveys, and illustrations are presented in Appendix C.

(4) Discussion:

(a) Temperatures

The temperature surveys showed that a submerged raw sewage inlet produced constant thermal conditions than a surface inlet. At Red Deer with the surface inlet on pond one a temperature stratification occurred. Approximately the top three feet of the liquid had a temperature ranging from 9 to 13 degrees centigrade. The temperature remained at nine degrees centigrade between the three foot layer and the bottom of the pond. Similar conditions were observed on ponds two and three where surface inlets are used. Meanwhile, at Medicine Hat where submerged inlets (about twofeet below the water surface) are used temperature stratifications were not obtained. The temperature difference between the surface and bottom was only 0.6 degrees centigrade.

From available temperature records of pond two at Red Deer, a rise in atmospheric temperature caused similar conditions in the sludge. The sludge temperature was several degrees colder than the liquid temperature at the surface. However, during the coldest part of winter, the sludge would be warmer than the atmospheric temperature. This was noted during the installation of the temperature indicator. The air temperature at that time was below zero degrees centigrade while the sludge temperature was five degrees. Therefore, during the winter, the raw sewage temperature is significant in providing adequate thermal conditions for stabilization. See table 27, page C-5.

(b) Sludge

Except for one sample, the pH of the sludge was never above 7.0 at all four centers. The variation in pH of the sludge for the four centers were: (a) Camrose 4.9 to 6.8, (b) Stettler 6.4 to 6.6, (c) Medicine Hat 4.6 to 7.1, and (d) Red Deer 5.1 to 6.7. The sludge was in an acid formation or acid regression stage as indicated by the pH values. Volatile matter and volatile acid analyses, however, show the sludge digestion progressing quite well at all four systems. Only samples obtained near the

raw sewage inlets were poorly digested as indicated by high volatile matters, a very putrid odor, and a structure consisting of individual particles.

Considerable differences in the sludge accumulation rates were found for the four systems. The rates varied from 2.38 cubic feet per day per 1,000 persons on pond two at Red Deer to 13.5 at pond one also at Red Deer.

The surveys at Red Deer on pond one indicated that the accumulation rate was high between October 1961 (began operation at this time) and June 1962; 13.5 ft.^{3}/day/1000 persons. However, the accumulation rate between June 1962 and October 1962 (during summer) was one-third the rate between October 1962 and June 1963, and about one-quarter the rate between October 1961 and June 1962. These rates were on basis of ft.^{3}/day/1000 persons. On the assumption that the suspended solids of the raw sewage were approximately the same throughout the periods considered, it does appear the temperature has some effect on the sludge digestion. The warmer temperatures experienced between June and October have, no doubt, accelerated the digestion process during this period, and consequently gave a smaller accumulation rate than during the other periods. It is difficult to assess what has caused the accumulation rate to be small in pond No. 2 other than the raw sewage was diverted to this pond in the summer, and has been used as a second cell since the system began operation in the fall of 1961.

At Camrose, the accumulation rates were approximately the same for the two surveys, 10.1 and 9.48 ft.3/day/1000 persons.

The accumulation rate at Medicine Hat was 4.22 ft.3/day/1000 persons for a one year operation, and at Stettler the rate was 8.75 ft.3/ day/1000 persons based on a three year operation.

At Camrose, Stettler, and Red Deer pond number one the accumulation rates were somewhat related to the suspended solids contribution per capita per day, and the suspended solids removed in the pond. In other words, the higher the suspended solids contribution, and percent removal, the larger the accumulation rate. However, the same was not true for Medicine Hat, and Red Deer pond number two. The accumulation rates were small in both ponds but the suspended solids reductions were high.

The location of the inlet had some effect on the distribution of the sludge in the pond. At Red Deer, Camrose, and Stettler where the inlets are near the berms, the sludge build-up was concentrated near the inlet side of the pond. At Medicine Hat where the inlet (a force main) was located further away from the berms, the sludge appeared to be distributed evenly in the pond than at the other three systems. This may have accounted for the small accumulation rate.

The sludge reduction rates as observed during the by-pass period on pond one at Red Deer were 1,360 cubic feet/day between July 1963 and September 1963, and 58.1 cubic feet/day between September 1963 and July 1964. During the period of July 1963 to freeze-up time, the pond surface was matted with floating sludge, and other debris buoyed up by gaseous compounds. Numerous bubbles, large and small, were also noticed on the surface, and judging by the number and their size, the anaerobic reaction appeared to be very vigorous. An odor of moderate concentration was detectable near the berms of the pond. Conditions under ice cover were not observed.

After the spring thaw the floating materials disappeared, and the water surface was covered with small bubbles indicating that the stabilization process was still continuing.

There are many other biological factors which were not considered in this study that affect the accumulation and digestion rates of the sludge in the ponds. However, the surveys do give an idea of the sludge accumulation rates and its composition in short detention ponds.

SUMMARY ON THE OPERATION OF LONG DETENTION PONDS

(1) General:

These stabilization ponds are in an aerobic state during the late spring, summer, fall, and early winter, and anaerobic during the winter. The detention periods of these ponds usually range from 3 to 6 months, and are designed to function as single or multicell units, or holding ponds if preceded by short detention ponds. Maximum operating level for the long detention ponds are usually five feet.

(2) B.O.D. Loading:

The stabilization ponds performed satisfactory at various B.O.D. loads for the system studied with only a few exceptions.

Of the long detention ponds not preceded by anaerobic cells, the B.O.D. loadings were: (a) Drayton Valley - 55.5 lb/acre/day, (b) Lacombe - 25.7 lb/acre/day, (c) Wetaskiwin (southeast) - 248 lb/acre/day. These were loads on the first cell of each system.

The single cell at Lacombe gave a winter efficiency of 30.1% reduction in B.O.D. while at Drayton Valley it was 48.8% for a two-pond unit, and 53.5% for a three-pond system. However, during the summer a high degree of treatment was obtained with 92.5% B.O.D. reduction at Drayton Valley and 92.0% at Lacombe.

A heavy organic load on the southeast system at Wetaskiwin created serious odor problems during the open water periods of 1963. At that time the ponds were loaded at 248 lb. B.O.D./acre/day. Although the loading was extremely high a B.O.D. reduction of 74.4% was obtained using two ponds in series. In order to prevent the reoccurrence of odors in the spring and summer of 1964 the system was operated in parallel during the winter of 1963-64. The raw sewage was diverted to three ponds thus reducing the B.O.D. load to 89.4 lb/acre/day. However, due to winter and low water level conditions, small B.O.D. reductions were obtained during the winter of 1963-64.

In the combined system, using anaerobic and aerobic ponds, the loading during the winter varied from 7.46 lb. B.O.D/acre/day at Stony Plain to 403 lb/acre/day at Evansburg while during the summer the loading ranged from 5.8 lb. B.O.D./acre/day at Stony Plain to 269 lb/acre/day at Evansburg.

The first long detention pond at Evansburg which was loaded at 269 lb. B.O.D./acre/day produced high odors during the summer. This pond never did turn aerobic (no D.O. presence) during the summer. The B.O.D. load on the second pond was 50.3 lb/acre/day and was aerobic throughout the summer with only a mild fishy odor.

The winter B.O.D. removals were quite variable for the combined short and long detention pond systems ranging from 62.5% B.O.D. reduction at Innisfail to 96.0% reduction at Evansburg. Summer B.O.D. reductions varied from 89.1% at Innisfail to 97.1% at Camrose.

Summer, winter, and yearly performances of all the long detention ponds are tabulated in Tables 20 to 22.

(3) Odors:

Only two systems, Wetaskiwin (southeast) and Evansburg, had odor problems throughout the summer.

At Evansburg the odor, as previously stated under anaerobic ponds, was due to high B.O.D. loadings applied to the ponds.

The odor problem which occurred in 1963 at Wetaskiwin was attributed to large volumes of wastes from a milk condensery plant thus overloading the ponds. To alleviate the high odors a number of chemicals such as sodium nitrate, lime, and phosphate were experimented on a small scale at field conditions. The use of these chemicals at various concentrations showed no significant improvements in the odor level. Then the city added acti-zyme to the raw sewage during the summer and fall. Various opinions have been expressed by personnels concerned with this system on the use and success of acti-zyme as a solution in relieving odors from sewage ponds. Since the fall of 1963 the system has been operated in parallel (using three ponds) and have resulted in minimum odors throughout the late spring and summer of 1964.

All other systems that were studied had high odors during a short period in the spring, otherwise odors were of very low concentration throughout the open water seasons.

(4) Chemical Quality:

Algal activity has affected the pH, dissolved oxygen, and alkalinity contents in the long detention ponds. The heavy growth of algae during the summer increased the pH of the supernatants to high values, 9.0 to 10.0, and corresponding decreased the total alkalinity, and raised the phenolphthalein in the winter lowered the pH and phenolphthalein alkalinity, but raised the total alkalinity. In all of the ponds except for a few readings, e.g. at Evansburg, the pH remained above 7.0 throughout the year.

The dissolved oxygen content varied for the spot checks that were taken from the various systems. In many of the ponds it was not uncommon for the dissolved oxygen to exceed the saturation values. With the exception of one pond at Evansburg and several ponds at Wetaskiwin dissolved oxygen was present in all the ponds that were investigated.

Generally in most ponds there were significant differences between the summer and winter ammonia-nitrogen concentrations. The peak readings were reached during the winter. During the summer the ammonia-nitrogen content was as low as 5 ppm. The decrease in ammonia-nitrogen concentration in the spring, summer, and early fall could be attributed to melting ice, bacterial oxidation, and algal activity.

Long detention ponds which are preceded by short detention cells generally had higher suspended solids in the summer than in the winter. Similar conditions were not observed in systems which consisted of only long detention ponds e.g. Drayton Valley and Wetaskiwin (southeast).

(5) Physical Quality:

No analysis on color was made. However, the color observed from the berms or in a sample bottle was a good indication of the pond condition, e.g. a rich green color indicated good aerobic action while a light gray appearance was anaerobic decomposition. In a series of ponds the green color during the summer became lighter as the liquid approached the final pond.

CONCLUSIONS AND RECOMMENDATIONS

(1) Of the five types of ponds studied the combined system consisting of short and long detentions have proven most efficient. It is recommended that the above type of ponding be used for communities with a population of at least 300 unless local or other conditions favor some other type of pond.

(a) Where the population is between 300 and 1,000 three short detention ponds of equal size and a sufficient number of long detention ponds are recommended.
(b) Where the population is greater than 1,000 four short detention ponds of equal size and a sufficient number of long detention ponds are recommended.
(c) The layout of the short detention ponds in the above cases should be such that series, parallel or parallel-series operations are permissible and provisions for by-passing either of the first two.
(d) Where the population is less than 300 two or more long detention ponds of equal size are recommended.

(2) Design details for short detention ponds:-

(a) Detention time - 2 to 4 days at the present sewage flow rate.
(b) Depth of water - 8 to 10 feet.
(c) Freeboard - 2 to 3 feet.
(d) Berms - inside slope 3:1 (minimum)
- outside slope 2:1 (minimum)
- top width - 10 feet
(e) Inlets and outlets - piping be used between ponds. Inlets and outlets should be submerged and located such that short circuiting will not occur. The inlet should be six feet and the outlet three feet below the water surface.
(f) B.O.D. Load - From the studies concluded the maximum B.O.D. removed was obtained at a loading of 6 lb./1000 $ft.^3$/day (about 2,700 lb/acre/day for a ten foot pond). However, it is recommended that the B.O.D. load not exceed 9 lb./1000 $ft.^3$/day (about 4,000 lb/acre/day for a ten foot pond) to provide an adequate degree of treatment and maintain minimum odors.

(3) Design details for long detention ponds:-

(a) Detention time - 3 to 6 months
(b) Depth of water - 5 feet
(c) Freeboard - 3 feet (2 feet in winter is adequate)
(d) Berms - inside slope 3 or 4:1
- outside slope 2 or 3:1
- top width 10 feet.
(e) Number of sections - two or more with detention time approximately the same in both. The ponds are to operate in series and be provided with overflows and drain lines.
(f) B.O.D. Load - not to exceed 50 lb/acre/day. If a large volume of industrial wastes are discharged to the pond the load should be reduced to 30 lb/acre/day.

(4) It is suggested the following items be considered when designing ponds:-

(a) types and volumes of wastes to be treated by the pond.
(b) if large volumes of industrial wastes are to be discharged in a municipal pond system pretreatment be provided.
(c) measuring flow devices for sewage flows, e.g. a weir or parshall flume be installed at all systems.

(5) Location - Sewage ponds should be located at least one half mile from the town boundary, one quarter mile from any residences and no less than 100 and preferably 300 feet from any road or railroad. For communities with a population of 10,000 or more the ponds should be located at least one mile and preferably two miles from the town limits.

(6) Drainage - Long detention ponds should not be drained to a water depth of less than one foot. Drainage should take place in the fall after it is certain that farm lands in the drainage course will not be adversely affected. The quality of the pond effluent is more suitable for release in the fall. If necessary ponds may be drained in spring when natural runoff occurs.

APPENDIX A

REPORTS ON INDIVIDUAL SYSTEMS

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PROVINCE OF ALBERTA

"LOCATION OF SEWAGE PONDS

INVESTIGATED IN THIS REPORT"

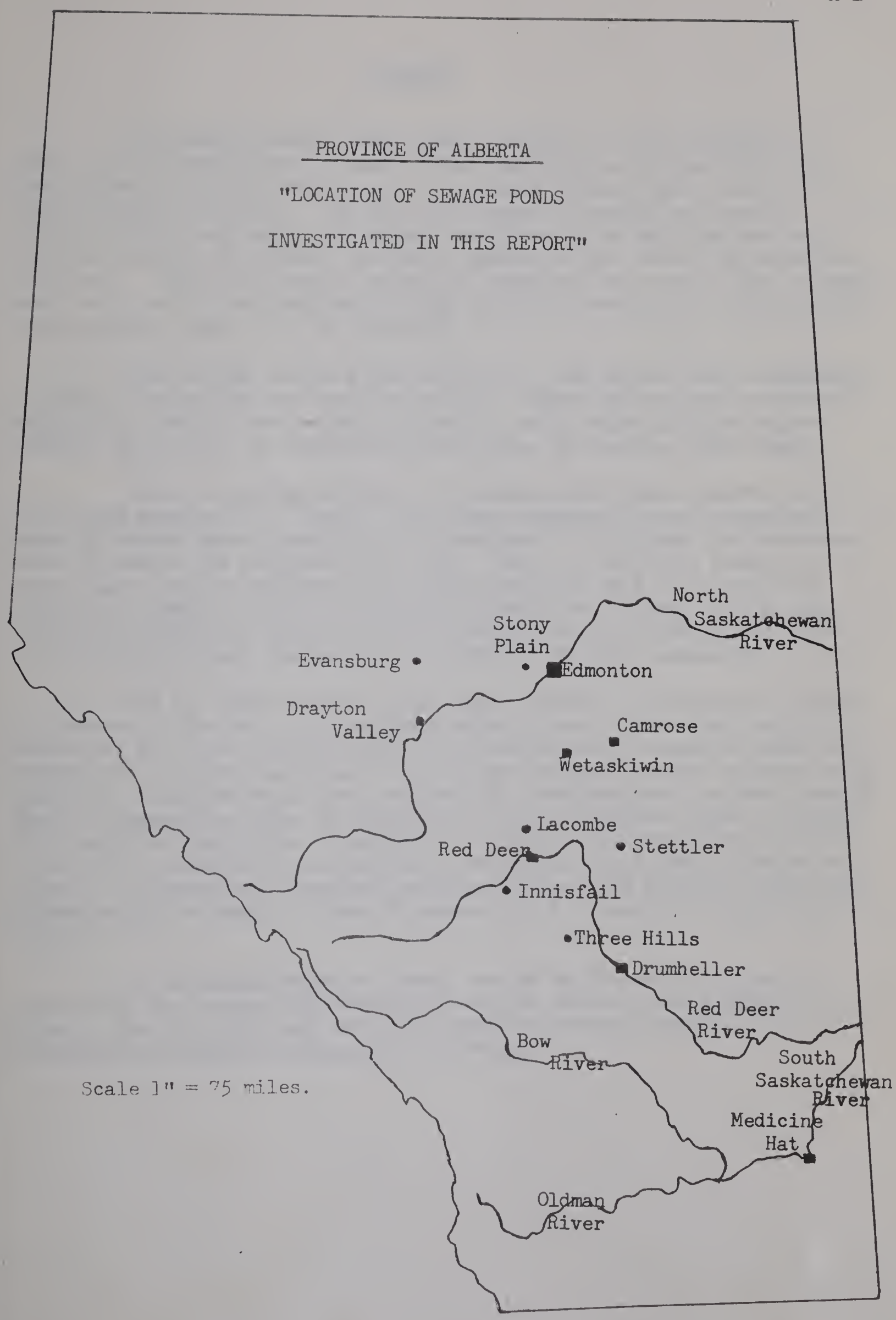

Figure 1

CAMROSE

The Camrose sewage pond system consists of four anaerobic ponds and two long detention ponds. Raw sewage flows by gravity to the first primary cell and overflows in the second primary cell, each of which are ten feet deep. From here the sewage is pumped into one of the secondary ponds (short detention), and then flows into the two long detention ponds. The normal operating depths for the secondary ponds are five feet. During the initial stages of operation only one of the secondary ponds was used. From November 28, 1962 till the conclusion of this project both secondary ponds were in operation.

This system serves a population of 7,708 with a school enrollment of 2,046 of which 256 are from the country. The only industry providing additional organic loads on the system is a dairy which produces approximately 57,000 lbs. of butter and 62,000 lbs. of powdered milk weekly.

Based on yearly averages, the first primary pond removed 41.7% of the raw sewage B.O.D. load. Using three anaerobic (short detention) ponds in series gave a yearly B.O.D. reduction of 45.6%,and four anaerobic ponds in series the reduction was 58.6%. The four anaerobic ponds in series had a winter performance of 52.8% reduction in B.O.D. and 77.6% during the summer. Three short detention ponds had a summer B.O.D. reduction of 71.6% while in the winter a rise in the B.O.D. value was noted in the third pond and therefore the efficiancy was not calculated.

The two long detention ponds have operated satisfactorily during all seasons of the year. The maximum organic load to the first long detention was 23.7 lbs./acre/day with the preceding short detention ponds as compared to 49.6 lbs./acre/day if these short detention cells were not used. Therefore it indicates the load to the long detention pond has been reduced about 50 percent by using the anaerobic or short detention ponds. Overall efficiency for the system, considering short and long detention ponds was 71.5% B.O.D. reduction in winter and a remarkable 98.1% during the summer. However, the additional treatment provided by the long detention ponds was approximately the same in terms of percent B.O.D. removed for summer and winter.

In the short detention ponds, the pH increased with detention time during the summer, but showed only slight pond to pond variation in the winter. The pH in the long detention ponds fluctuated between 7.3 and 9.1 with minimum readings occurring in the spring.

The ammonia-nitrogen content in the short detention cells showed small variations between the ponds throughout the year. Increases were noted either in the fall or the winter and minimum readings were observed in the summer. During the summer marked differences in the ammonia-nitrogen concentration were noted between the short detention and long detention ponds. However, in the winter the ammonia-nitrogen of the long detention ponds approached the same level of concentrations as in the short detention cells.

During the summer the second primary pond and the two secondary ponds had distinct green colors indicating the presence of algal blooms. A good growth of algae was noted in the first long detention pond and smaller amounts in the second long detention pond. The color in the second long detention pond had a color ranging from very light green to colorless (clear) throughout the spring and summer. Generally suspended solids decreased with detention time in the long detention ponds.

Suspended solids showed marked changes between summer and winter. The high concentration of suspended solids in the summer could be attributed to algae in the ponds.

No significant changes of total solids occurred from pond to pond throughout the year in the short detention cells. Peak values were reached in the summer and minimum values were in the winter. In the long detention ponds, however, peak readings seem to have occurred in the winter, and except for a few low readings in the spring the concentration level was approximately the same.

Odors in the general vicinity of the long detention ponds were nil throughout the year. Near the secondary ponds the odor was of slight concentration during the period of open water. Odors of moderate to high intensity were detectable near the primary ponds at all times of the year.

Ice cover in the primary ponds ranged from nil to a foot during the winter. Generally a large area near the inlet of both ponds were open throughout the winter. Similar conditions were experienced in the secondary ponds. Maximum ice cover in the secondary and long ponds was three and a half feet.

Plan of Camrose Sewage Ponds

Scale 1" = 500'
* - Sampling Location
→ - Flow Route
--→ - Alternate Flow Route

Area - (Acres)

Primary 1 - 1.1
2 - 1.0
Secondary 1 - 1.2
2 - 1.2
Long Detention 1 - 35.3
2 - 32.4

Capacity - (Million Gals)

Primary 1 - 2.95 @ 10ft. Depth
2 - 2.73 @ 10ft. Depth
Secondary 1 - 1.64 @ 5' Depth
2 - 1.64 @ 5' Depth
Long Detention
1 - 48.2 @ 5' Depth
2 - 44.2 @ 5' Depth

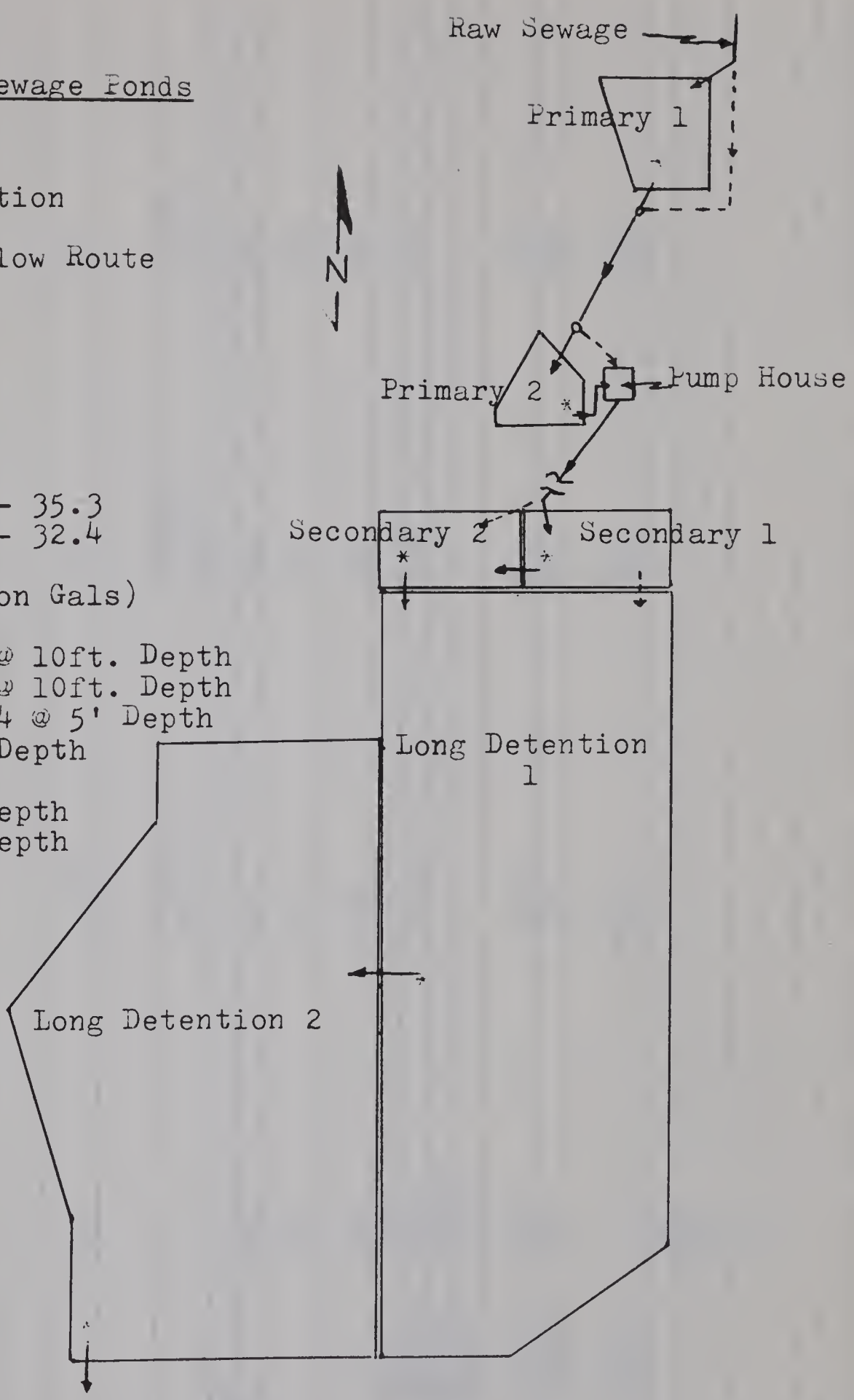

Figure ?

Table 2A

SEWAGE POND STUDY

Location Camrose Raw Sewage Sampling Point

Date		Feb. 21/62	Oct. 30/63	May 20	May 21/64
Time			8:00 am - 12 midnight	8:00 am - 8:00 pm	8:00 am - 8:00 pm
Wind, mphr.					
Light, fo.					
pH		8.0	7.65	7.4	7.7
D.O. ppm			Varied	Varied	Varied
Temperature °C.			15 - 16	14 - 16	14 - 16
Alkalinity, ppm	pp	-	-	-	-
	MO	555	455	510	375
Odor, T.O.N.		200	200	200	100
B.O.D., ppm		571	303	343	260
Nitrogens, ppm	Total	68.0			
	Ammonia	36.0	33.8	43.5	22.5
	Nitrite	0.015			
	Nitrate	0.425			
Total Solids ppm	Total	1464	1178	1368	1421
	Volatile	556	433	471	464
Suspended Solids, ppm	Total		308	404	440
	Volatile		284	348	236
Chlorides ppm		180			
Sulfates ppm		134			
Phosphates ppm		53			
Detergents ppm		10.7			
Ice, feet					
Liquid, feet					
Overflow					

Table 2B

SEWAGE POND STUDY

Location: Camrose Primary #1 (Short) — Sampling Point: Outfall of Primary #1

Date		Nov. 30/61	Dec. 27	Jan. 24/62	Feb. 21	Mar. 21	Apr. 18	July 13	Aug. 9
Time		11:40 am	12:00 pm	10:50 am	9:45 am	4:20 pm	10:30 am	10:30 am	11:05 am
Wind, mphr.		Calm	Calm	Calm	Calm	10	5	Calm Cloudy	10
Light, fo.		850	1000+	1000+	1000+	1000+	1000+	–	Sunny
pH		7.4	7.0	7.3	7.4	7.4	7.5	7.4	7.4
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		3.5	2.0	1.5	2.5	2.5	10.0	17	20
Alkalinity, ppm	pp	–	–	–	–	–	–	–	–
	MO	425	435	460	525	505	550	475	510
Odor, T.O.N.		1600	8000	200	400	1000	1000	–	2000
B.O.D., ppm		267	225	157	251	256	215	180	243
Nitrogens, ppm	Total	44.5	59.5	53.0	56.1	50.8	56.3		
	Ammonia	55.5	53.0	42.5	42.0	48.0	56.0	31.5	28
	Nitrite	0.005	Nil	Nil	0.010	0.070	0.010		
	Nitrate	0.120	0.095	0.162	0.095	0.675	0.190		
Total Solids ppm	Total	1069	1025	937	981	995	1167	1231	1541
	Volatile	304	310	277	310	241	267	364	582
Suspended Solids, ppm	Total	40	68	95	102	86	101	142	360
	Volatile	12	68	83	90	76	84	142	240
Chlorides ppm		117	110	86	94	122	120		
Sulfates ppm		160	165	145	143	141	139		
Phosphates ppm		47	55	49	49	47	55		
Detergents ppm		–	12.3	10.7	7.2	8.3	9.4		
Ice, feet		0.2	1.0	0.1	0.1	0.1	–	–	
Liquid, feet		3.0	3.0	5.0	4.0	4.0	4.0	2.0	0.8"
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Camrose Primary #1 (Short) Sampling Point Outfall of Primary #1

Date	Oct. 4/62	Nov. 28	Dec. 27	Jan. 30/63	Feb. 27	ar. 27	April 24	Aug. 14
Time	11:00 a.m.	10:50 a.m.	11:55 a.m.	12:15 p.m.	4:30 p.m.	11:20 a.m.	11:15 a.m.	1:30 p.m.
Wind, mphr.	Calm	Calm	Calm	Calm	10	Calm	10	Calm
Light, fo.	700	1000+	800	1000+	800	1000+	1000+	1000+
pH	7.35	7.3	7.7	7.6	7.65	7.5	7.4	7.30
D.O. ppm	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature C.	12	4	3	1	5	9	11	23
Alkalinity, ppm pp MO	-	-	-	-	-	-	-	-
	535	470	475	455	435	425	445	580
Odor, T.O.N.	500	1500	6000	5000	4000	1500	2000	3000
B.O.D., ppm	257	233	211	216	210	176	207	191
Nitrogens, ppm — Total Ammonia	39.5	41.5	46.7	40	33.5	37.5	30.5	35.5
Nitrogens, ppm — Nitrite								
Nitrogens, ppm — Nitrate								
Total Solids ppm — Total	1242	1081	1013	1066	1018	1042	932	1462
Total Solids ppm — Volatile	373	295	270	309	259	291	336	340
Suspended Solids, ppm — Total	96	96	96	85	64	52	106	128
Suspended Solids, ppm — Volatile	96	94	77	77	62	44	92	124
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Color	Light green							
Ice, feet	-	0	0.3	0.3	-	-	-	-
Liquid, feet	0.8	0.8						
Overflow	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Camrose Primary #1 (Short) Sampling Point Outfall of Primary #1

Date		Oct. 30/63	Feb. 12/64	Mar. 18
Time		1:30 pm	11:25 am	11:10 am
Wind, mphr.		Calm	Calm	15
Light, fo.		1000+	1000	1000
pH		7.30	7.35	7.3
D.O. ppm		-	Nil	Nil
Temperature °C.		6	4	4
Alkalinity, ppm	pp	-	-	-
	MO	525	500	485
Odor, T.O.N.		800	3000	1000
B.O.D., ppm		140	235	233
Nitrogens, ppm	Total			
	Ammonia	48.8	31.5	37.5
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1381	918	1025
	Volatile	340	230	281
Suspended Solids, ppm	Total	192	66	73
	Volatile	128	60	59
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		-	-	-
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 2C

SEWAGE POND STUDY

Location: Camrose Primary #2 (Short) — Sampling Point: Outlet of #2 in Pond

Date		Nov. 30/61	Dec. 27	Jan. 24/62	Feb. 21	Mar. 21	April 18	July 13	Aug. 9
Time		11:30 am	12:10 pm	11:00 am	9:30 am	4:40 pm	10:20 am	10:20 am	11:00 am
Wind, mphr.		Calm	Calm	Calm	Calm	10	5	Calm Cloudy	10
Light, fo.		900	1000+	1000+	1000+	1000+	1000+		Sunny
pH		7.0	6.9	7.1	7.2	7.2	7.2	7.45	7.45
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		2.0	1.0	0.5	1.0	1.5	9.0	17	20
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	460	430	500	545	545	550	525	525
Odor, T.O.N.		2000	4000	4000	1200	1000	1200	-	1000
B.O.D., ppm		373	185	194	207	240	198	158	173
Nitrogens, ppm	Total	48.6	59	55	60.8	48.0	52.5		
	Ammonia	80	49	51	44.0	52.0	52.0	31.5	20
	Nitrite	0.004	Nil	Nil	Nil	0.060	0.010		
	Nitrate	0.080	0.162	0.095	Nil	0.300	0.100		
Total Solids ppm	Total	1369	1004	1040	1096	1105	1176	1218	1500
	Volatile	397	327	299	336	149	292	205	394
Suspended Solids, ppm	Total	40	57	105	111	59	56	104	222
	Volatile	8	57	97	111	56	38	104	220
Chlorides ppm		212	118	122	132	128	138		
Sulfates ppm		100	154	145	150	152	150		
Phosphates ppm		75	57	54	48	50	49		
Detergents ppm		-	12.0	11.2	6.9	7.4	7.6		
Color									Dark green
Ice, feet		0.4	1.0	0.5	0.5	0.2	-		
Liquid, feet		5.0	3.0	4.0	5.0	5.0	3.0		
Overflow*									

*Pumped to Secondary #2

SEWAGE POND STUDY

Location Camrose Primary #2 (Short) Sampling Point Outlet of No. 2 Pond

Date		Oct. 4/62	Nov. 28	Dec. 27	Jan. 30/63	Feb. 27	Mar. 27	April 24	Aug. 14
Time		10:55 am	10:45 am	11:45 am	Noon 12:00	4:20 pm	11:15 am	11:10 am	1:40 pm
Wind, mphr.		Calm	Calm	Calm	Calm	10	Calm	11	Calm
Light, fo.		700	1000+	800	1000+	800	1000+	1000+	1000+
pH		7.4	7.35	7.7	7.55	7.45	7.6	7.4	7.5
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		11	2°	2	1	4	8	11	23
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	590	555	580	530	455	453	483	525
Odor, T.O.N.		250	1500	5000	4000	6000	3000	1000	2000
B.O.D., ppm		188	236	204	179	187	157	168	177
Nitrogens, ppm	Total Ammonia	44.5	48.5	52	45.5	38	36	36	26.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1297	1115	1112	1087	1062	1014	1226	1627
	Volatile	362	303	266	278	277	254	273	474
Suspended Solids, ppm	Total	58	144	93	50	37	42	80	280
	Volatile	36	140	90	48	37	36	70	276
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color		Light green							
Ice, feet			0.1	0.5	0.5	0.5	-	-	-
Liquid, feet									
Overflow*									

*Pumped to Secondary #2

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SEWAGE POND STUDY

Location: Camrose Primary #2 (Short) — Sampling Point: Outlet of #2 in Pond

		Oct. 30/63	Feb. 12/64	Mar. 18
Date				
Time		1:45 pm	11:15 am	11:00 am
Wind, mphr.		Calm	Calm	15
Light, fo.		1000+	1000	1000+
pH		7.50	7.45	7.3
D.O. ppm		-	Nil	Nil
Temperature °C.		6	2	1
Alkalinity, ppm	pp	-	-	-
	MO	605	505	565
Odor, T.O.N.		500	1000	2000
B.O.D., ppm		135	190	228
Nitrogens, ppm	Total			
	Ammonia	50.0	33.5	42.0
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1148	882	999
	Volatile	287	236	261
Suspended Solids, ppm	Total	104	66	48
	Volatile	90	60	48
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		-	0.5 to 1'	0.5
Liquid, feet				
Overflow				

Table 2D

SEWAGE POND STUDY

Location Camrose Secondary 1 (Short) Sampling Point Outfall of Secondary #1

Date		Nov.28/62	Dec. 27	Jan. 30/63	Feb. 27	Mar.27/63	April 24	Aug. 14	Oct. 30
Time		10:20a.m.	11:35 a.m.	11:45a.m.	4:10p.m.	11:05a.m.	10:55a.m.	1:50 p.m.	1:45p.m.
Wind, mphr.		Calm	Calm	Calm	10	Calm	10	Calm	Calm
Light ...		1000+	500	1000+	800	1000+	1000+	1000 +	1000+
pH		7.3	7.8	7.55	7.5	7.7	7.65	7.6	7.9
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		2	2	0.5	3	6	9	23	6
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	545	610	560	505	460	540	640	700
Odor, T.O.N.		1200	4000	3000	5000	2000	600	700	500
B.O.D., ppm		195	208	175	190	149	128	150	119
Nitrogens, ppm	Total Ammonia	43.2	56.5	45.5	38.5	37	39.5	29.5	51.3
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1220	1154	1117	1053	984	1188	1452	1142
	Volatile	325	270	290	262	284	255	368	293
Suspended Solids, ppm	Total	56	69	48	63	39	52	102	100
	Volatile	50	64	46	63	30	52	98	88
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		0.1	0.5	1	0-1.0	--	--	--	--
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Camrose Secondary #1 (Short) Sampling Point Outfall of Secondary #1

Date		Feb.12/64	Mar. 18
Time		10:55a.m.	10:45a.m.
Wind, mphr.		Calm	15
Light, fo.		1000	1000+
pH		7.3	7.5
D.O. ppm		NIL	NIL
Temperature °C.		2	1
Alkalinity, ppm	pp	--	--
	MO	560	550
Odor, T.O.N.		1000	1000
B.O.D., ppm		148	186
Nitrogens, ppm	Total Ammonia	35	41.5
	Nitrite		
	Nitrate		
Total Solids ppm	Total	927	1000
	Volatile	225	262
Suspended Solids, ppm	Total	38	38
	Volatile	34	36
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		2.5	2.5
Liquid, feet			
Overflow		Yes	Yes

Table 2E

SEWAGE POND STUDY

Location Camrose Secondary #2 (Short) **Sampling Point** Outfall of Secondary #2

Date		Nov.30/61	Dec. 27	Jan.24/62	Feb. 21	March 21	April 18	July 13	Aug. 9/62
Time		11:00a.m.	11:15a.m.	9:45a.m.	8:50a.m.	3:20p.m.	10:00a.m.	9:30a.m.	10:00 a.m.
Wind, mphr.		10	Calm	10	Calm	20	10	Calm Cloudy	10
Light, fo.		300	1000+	300	1000+	1000+	1000+		Sunny
pH		7.2	7.0	7.1	7.1	7.3	7.5	7.8	7.5
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C		0.5	0.5	0.2	0.2	0.2	8.0	18	18
Alkalinity, ppm	pp	--	---	--	--	--	--	--	--
	MO	510	470	525	550	575	545	575	590
Odor, T.O.N.		2000	4000	4000	4000	3000	1250	--	200
B.O.D., ppm		212	236	223	267	235	158	118	96
Nitrogens, ppm	Total	47.5	57.5	51.0	41.5	55.5	52.5		
	Ammonia	40.0	45.0	42.0	42.5	50.0	40.0	31.0	25.2
	Nitrite	0.004	NIL	NIL	NIL	0.073	0.010		
	Nitrate	0.13	0.125	0.100	0.005	0.375	0.025		
Total Solids ppm	Total	1249	1078	1103	1062	1034	1118	1260	1330
	Volatile	268	286	323	333	270	261	318	302
Suspended Solids, ppm	Total	64	55	68	120	90	33	85	84
	Volatile	3	55	68	120	90	33	84	87
Chlorides ppm		127	120	144	138	140	132		
Sulfates ppm		140	142	130	149	120	118		
Phosphates ppm		75	60	52	51	52	50		
Detergents ppm		--	12.0	12.8	9.2	6.8	7.8		
Color									green
Ice, feet		0.6	3.0	2.5	2.5	2.0	-		
Liquid, feet		3.0	2.0	2.0	3.0	3.0	3.0		
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Camrose Secondary #2 (Short) Sampling Point Outfall of Secondary #2

Date		Oct. 4/62	Nov. 28	Dec. 28	Jan. 30/63	Feb. 27	Mar. 27	April 24	Aug. 14
Time		10:45 am	10:30 am	11:25 am	11:35 am	4:00 pm	11:00 am	10:50 am	1:55 pm
Wind, mphr.		Calm	Calm	Calm	Calm	10	Calm	10	Calm
Light, fc.		700	1000+	800	1000+	800	1000+	1000+	1000+
pH		7.8	7.4	7.9	7.7	7.65	7.6	7.8	7.6
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		11	3	2	0.5	2	5	9	23
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	625	573	650	565	740	625	540	605
Odor, T.C.N.		80	400	4000	2000	5000	1000	400	600
B.O.D., ppm		140	195	205	164	157	133	130	83
Nitrogens, ppm	Total Ammonia	47	45.7	58	45	39.5	45	37.5	26.8
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1266	1133	1166	1128	1402	1175	1135	1116
	Volatile	369	307	269	280	309	264	253	584
Suspended Solids, ppm	Total	75	52	54	56	23	24	36	70
	Volatile	60	48	50	50	22	23	36	66
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color									Green
Ice, feet		-	0.3	1.0	2.5	2.0	1.0	-	-
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location: Camrose Secondary #2 (Short) — Sampling Point: Outfall of Secondary #2

Date		Oct. 30/63	Feb. 14/64	Mar. 18					
Time		1:50 pm	11:05 am	10:30 am					
Wind, mphr.		Calm	Calm	15					
Light, fo.		1000+	1000+	1000+					
pH		7.95	7.15	7.45					
D.O. ppm		-	Nil	Nil					
Temperature °C.		5	1	1					
Alkalinity, ppm	pp	-	-	-					
	MO	735	520	740					
Odor, T.O.N.		300	500	700					
B.O.D., ppm		116	142	145					
Nitrogens, ppm	Total Ammonia	51.3	36	48.8					
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1146	881	1159					
	Volatile	327	212	325					
Suspended Solids, ppm	Total	82	36	20					
	Volatile	76	32	18					
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		-	2.5	2.5					
Liquid, feet									
Overflow		Yes	Yes	Yes					

Table 2F

SEWAGE POND STUDY

Location: Camrose Long Detention #1 — Sampling Point: Overflow to Long Detention #2

Date		Nov. 30/61	Dec. 27	Jan. 24/62	Feb. 21	Mar. 21	April 18	July 13	Aug. 9
Time		10:40 am	11:30 am	10:00 am	9:00 am	3:40 pm	9:45 am	9:45 am	10:30 am
Wind, mphr.		10	Calm	10	Calm	20	10	Calm Cloudy	10
Light, fo.		900	1000+	300	1000+	1000+	1000+		Sunny
pH		8.6	7.5	7.5	7.4	7.4	7.3	8.3	9,1
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	3.2	14.4
Temperature °C.		0.5	0.5	0.2	0.2	0.1	1.5	19	19
Alkalinity, ppm	pp	19.0	-	-	-	-	-	-	51
	MO	600	695	825	825	700	235	435	300
Odor, T.O.N.		800	2000	6000	6000	6000	2000	-	10
B.O.D., ppm		49	126	129	168	237	38	17	20
Nitrogens, ppm	Total	40.5	39.4	51.0	57.4	57.9	24.1		
	Ammonia	17.5	20.0	47.0	41.5	57.0	26.0	14.5	8.5
	Nitrite	0.005	Nil	Nil	Nil	0.055	0.010		
	Nitrate	0.15	0.125	0.105	0.006	0.400	0,100		
Total Solids ppm	Total	1116	1427	1459	1409	1363	444	1048	973
	Volatile	50	333	338	361	356	105	294	207
Suspended Solids, ppm	Total	34	19	27	69	59	18	103	69
	Volatile	10	19	27	69	59	18	88	68
Chlorides ppm		175	190	198	184	182	52		
Sulfates ppm		200	200	145	165	160	50		
Phosphates ppm		32.5	51	60	56	61	19		
Detergents ppm		-	11.0	14.9	10.2	10.7	3.0		
Ice, feet		0.75	2.5	3.0	3.0	3.0	-	-	-
Liquid, feet		6.0	3.0	1.0	2.0	3.0		5½'	
Overflow			Yes	Yes	Yes	Yes		Yes	Yes

Sample taken from overflow

SEWAGE POND STUDY

Location Camrose Long Detention #1 Sampling Point Overflow to Long Detention #2

Date		Oct. 4/62	Nov. 28	Dec. 28	Jan. 30/63	Feb. 27	Mar. 27	April 24	Aug. 14
Time		10:25 am	10:15 am	10:55 am	11:15 am	3:50 pm	10:45 am	10:45 am	2:00 pm
Wind, mphr.		Calm	Calm	Calm	Calm	10	Calm	10	Calm
Light, fo.		700	1000+	800	1000+	800	1000+	1000+	1000+
pH		8.8	7.6	8.2	7.9	7.7	7.85	7.35	8.15
D.O. ppm		8.2	Nil	Nil	Nil	Nil	Nil	Nil	5.4
Temperature °C.		11	2°	2	0	2	5	6	23
Alkalinity, ppm	pp	65	-	-	-	-	-	-	-
	MO	340	505	695	825	775	635	190	500
Odor, T.O.N.		4	50	2000	2000	3000	1000	100	10
B.O.D., ppm		36	39	76	122	168	175	54	5
Nitrogens, ppm	Total Ammonia	7.5	18.5	33.5	40.5	40.5	40.3	13.5	18
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1150	1159	1331	1559	1392	1142	341	1086
	Volatile	323	238	238	318	314	237	90	156
Suspended Solids, ppm	Total	150	37	32	32	18	24	24	23
	Volatile	145	36	31	30	18	20	22	20
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color		Rich green	Clear						Light yellow
Ice, feet		-	½"	1½"	3"	2.5	3	Melting	
Liquid, feet			5	4.5	2.0				
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location: Camrose Long Detention #1 — Sampling Point: Overflow to Long Detention #2

Date		Oct. 30/63	Feb. 14	Mar. 18
Time		2:00 pm	10:45 am	10:15 am
Wind, mphr.		Calm	Calm	15
Light, fo.		1000+	1000+	1000+
pH		8.30	7.45	7.5
D.O. ppm		-	Nil	Nil
Temperature °C.		4	1	1
Alkalinity, ppm	pp	-	-	-
	MO	625	870	770
Odor, T.O.N.		10	300	800
B.O.D., ppm		18	120	148
Nitrogens, ppm	Total			
	Ammonia	31.3	45	50
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1176	1414	1179
	Volatile	272	312	322
Suspended Solids, ppm	Total	64	24	22
	Volatile	48	18	20
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		Thin ice	2.5	2.5
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 2G

SEWAGE POND STUDY

Location Camrose Long Detention #2 Sampling Point Outfall of Long Detention #2

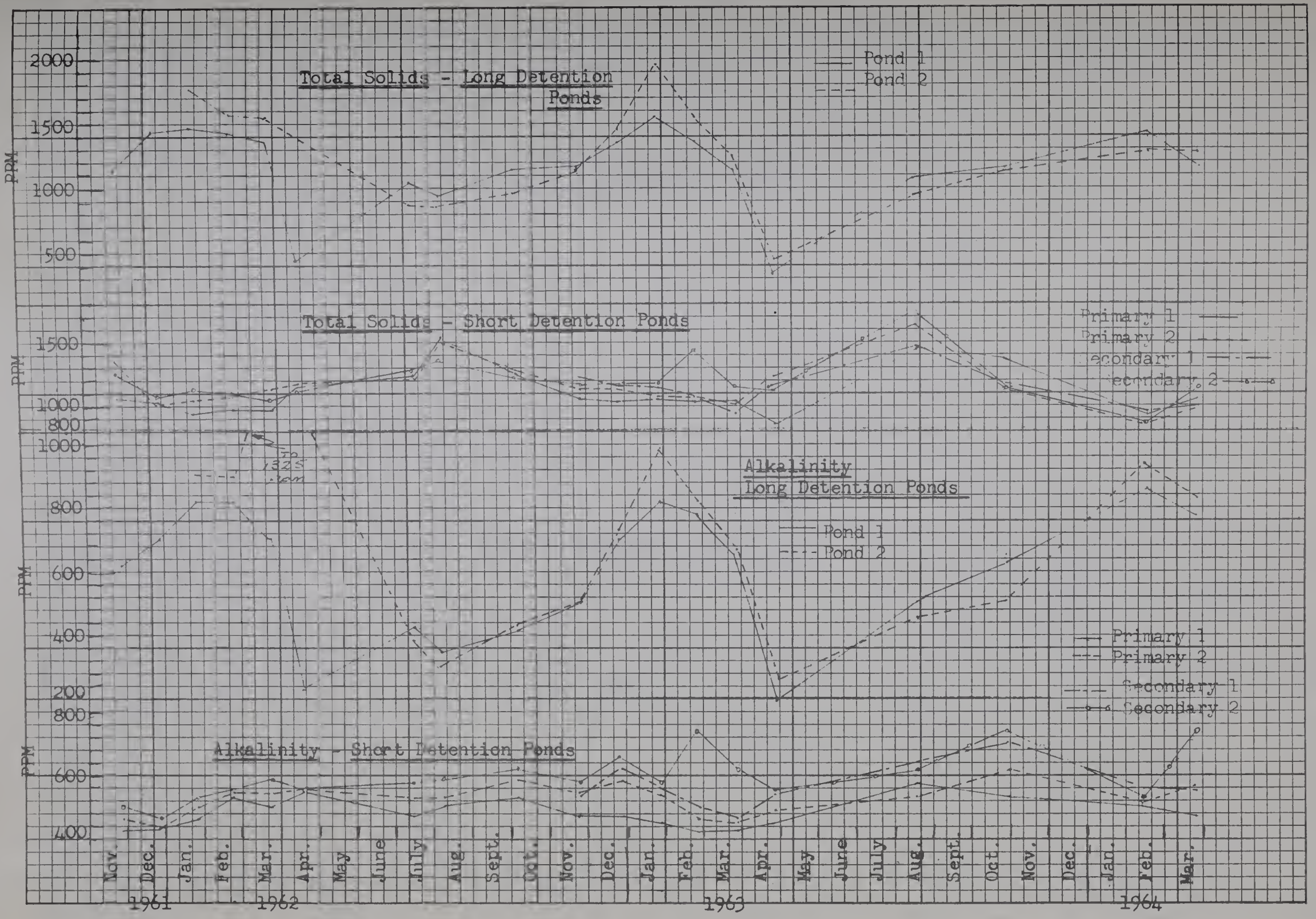
Date		Jan. 24/62	Feb. 21	Mar. 21	July 13	Aug. 9	Oct. 4	Nov. 28	Dec. 27
Time		10:30 am	9:20 am	4:00 pm	10:00 am	10:45 am	10:30 am	10:00 am	11:10 am
Wind, mphr.		Calm	Calm	20	Calm Cloudy	10	Calm	Calm	Calm
Light, fo.		320	1000+	1000+		Sunny	700	1000	800
pH		7.6	7.5	8.2	8.8	8.6	7.95	7.9	8.4
D.O. ppm		Nil	Nil	Nil	7.5	3.0	5.1	0.4	Nil
Temperature °C.		0.2	0.2	0.1	19	20	11	2	2
Alkalinity, ppm	pp	-	-	-	50	25	-	-	5
	MO	930	925	1325	325	275	420	500	720
Odor, T.O.N.		5000	5000	5000		6	2 musty	4	800
B.O.D., ppm		80	160	306	12	4	7	6	26
Nitrogens, ppm	Total	42	60.8	91.8					
	Ammonia	38	43.5	90.0	6.0	1.0	9.5	10	22.5
	Nitrite	Nil	Nil	0.041					
	Nitrate	0.200	0.050	0.625					
Total Solids ppm	Total	1788	1594	1541	881	853	962	1133	1462
	Volatile	393	390	342	232	136	232	340	265
Suspended Solids, ppm	Total	28	45	64	43	3	52	14	22
	Volatile	28	45	54	40	3	52	11	20
Chlorides ppm		238	208	236					
Sulfates ppm		218	181	165					
Phosphates ppm		61	61	53					
Detergents ppm		12.5	11.2	15.0					
Color						Clear	Clear	Clear	
Ice, feet		3.0	3.0	3.0				½'	1½'
Liquid, feet		1.0	2.0	1.0				4	4
Overflow		No	No	No	Yes	Yes	Yes at overflow	Yes	Yes

Overflow from Long Detention #1 first occurred Aug. 13/61 but at low rate. First good sample obtained Jan. 24/62.

SEWAGE POND STUDY

Location Camrose Long Detention #2 Sampling Point Outfall of Long Detention #2

Date		Jan. 30/63	Feb. 27	Mar. 27	April 24	Aug. 14	Oct. 30	Feb. 12/64	Mar. 18
Time		11:00 am	3:25 pm	10:30 am	10:30 am	2:10 pm	2:15 pm	10:30 am	10:00 am
Wind, mphr.		Calm	10	Calm	10	Calm	Calm	Calm	15
Light, fo.		1000+	800	1000+	1000+	1000+	1000+	1000+	1000+
pH		8.00	7.75	7.7	7.45	8.3	8.4	7.6	7.5
D.O. ppm		Nil	Nil	Nil	Nil	3.5	-	Nil	Nil
Temperature °C.		0	1	3	5	23	4	1	1
Alkalinity, ppm	pp	-	-	-	-	-	10	-	-
	MO	975	815	675	270	450	480	945	835
Odor, T.O.N.		500	800	800	50	10	10	200	200
B.O.D., ppm		75	149	119	48	4	34	112	133
Nitrogens, ppm	Total Ammonia	47	39.5	42.5	13.5	12.0	8.8	48.5	49.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1974	1536	1254	418	935	1123	1291	1285
	Volatile	341	337	275	90	176	256	275	245
Suspended Solids, ppm	Total	29	23	10	16	14	38	8	32
	Volatile	23	23	10	14	14	36	6	26
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color						Clear	Clear	Very light green	
Ice, feet		3'	3'	3	Melting		Thin ice	3.0	2.5
Liquid, feet		≈							
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes


Total Solids - Long Detention Ponds
Pond 1
Pond 2
PPM
2000
1500
1000
500
Total Solids - Short Detention Ponds
Primary 1
Primary 2
Secondary 1
Secondary 2
1500
1000
800
1000
800
600
400
200
800
600
400
Alkalinity
Long Detention Ponds
Pond 1
Pond 2
Primary 1
Primary 2
Secondary 1
Secondary 2
Alkalinity - Short Detention Ponds
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
1961
1962
1963
1964

Camrose

B.O.D. - Long Detention Ponds

— Pond 1
--- Pond 2

B.O.D. - Short Detention Ponds

— Primary 1
--- Primary 2
—·— Secondary 1
—°— Secondary 2

PPM

250
200
150
100
50
350
300
250
200
150
100

Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1961 1962 1963 1964

Camrose

pH - Long Detention Ponds

9.0
8.5
8.0
7.5
7.0

Pond 1
Pond 2

pH - Short Detention Ponds

8.0
7.5
7.0

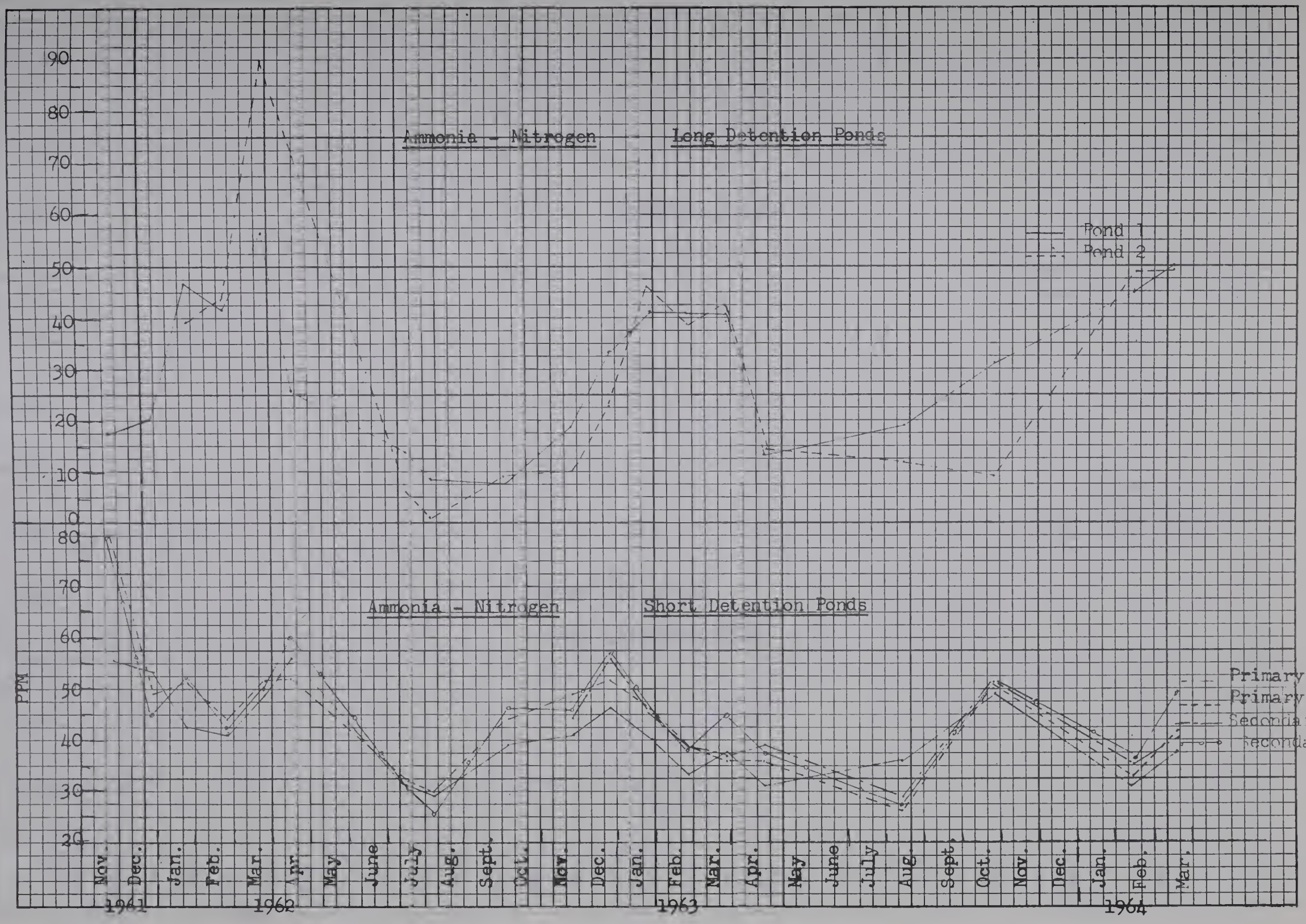
Primary 1
Primary 2
Secondary 1
Secondary 2

Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1961 1962 1963 1964

Camrose

Ammonia - Nitrogen - Long Detention Ponds



Ammonia - Nitrogen - Short Detention Ponds

Camrose

Suspended Solids

Long Detention Ponds

PPM

150
100
50
0

Pond 1
Pond 2

300
250
200
150
100
50

Primary 1
Primary 2
Secondary 1
Secondary 2

Suspended Solids

Short Detention Ponds

Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1961 1962 1963 1964

Camrose

Dissolved Oxygen

Long Detention Ponds

PPM

10

0

Pond 1

Pond 2

Odor - Long Detention Ponds

T.O.N.

5000

0

8000

Odor - Short Detention Ponds

T.O.N.

5000

0

Primary 1

Primary 2

Secondary 1

Secondary 2

Temperature

Short Detention Ponds

°C

20

15

10

5

Primary 1

Primary 2

Secondary 1

Secondary 2

Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1961 1962 1963 1964

Camrose

A-77

DRAYTON VALLEY

The Drayton Valley sewage lagoon system, consisting of three long detention ponds, has been previously studied and the results were published in 1961. During this recent investigation period, the second pond was bypassed between December 20th, 1961 and April 11th, 1962; thereafter the three pond set-up was used. This system serves a population of 3,533 and the usual business outlets.

The average winter performance of a two-pond and a three-pond system varied only by 4.7 percent with the latter having the higher efficiency of 53.5% reduction in B.O.D. In each case, the % B.O.D. reduction in the first pond was approximately the same; 28.2% for the two-pond setup and 29.1% for the three-pond setup. During the summer, a B.O.D. reduction of 92.5% was obtained using three ponds in series with 70.5% of the total occurring in the first pond. As a single system, approximately the same degree of treatment, in terms of percent B.O.D. reduction, were provided by the second and third ponds during summer and winter. However, as individual units the percent B.O.D. removed by each pond varied for summer and winter.

The pH of the liquid in the three ponds ranged from 7.0 to 9.5. Algal blooms during the summer caused the pH to reach their maximum values. A decrease in the pH occurred during the fall and early winter. In all three ponds the minimum pH readings were obtained in winter.

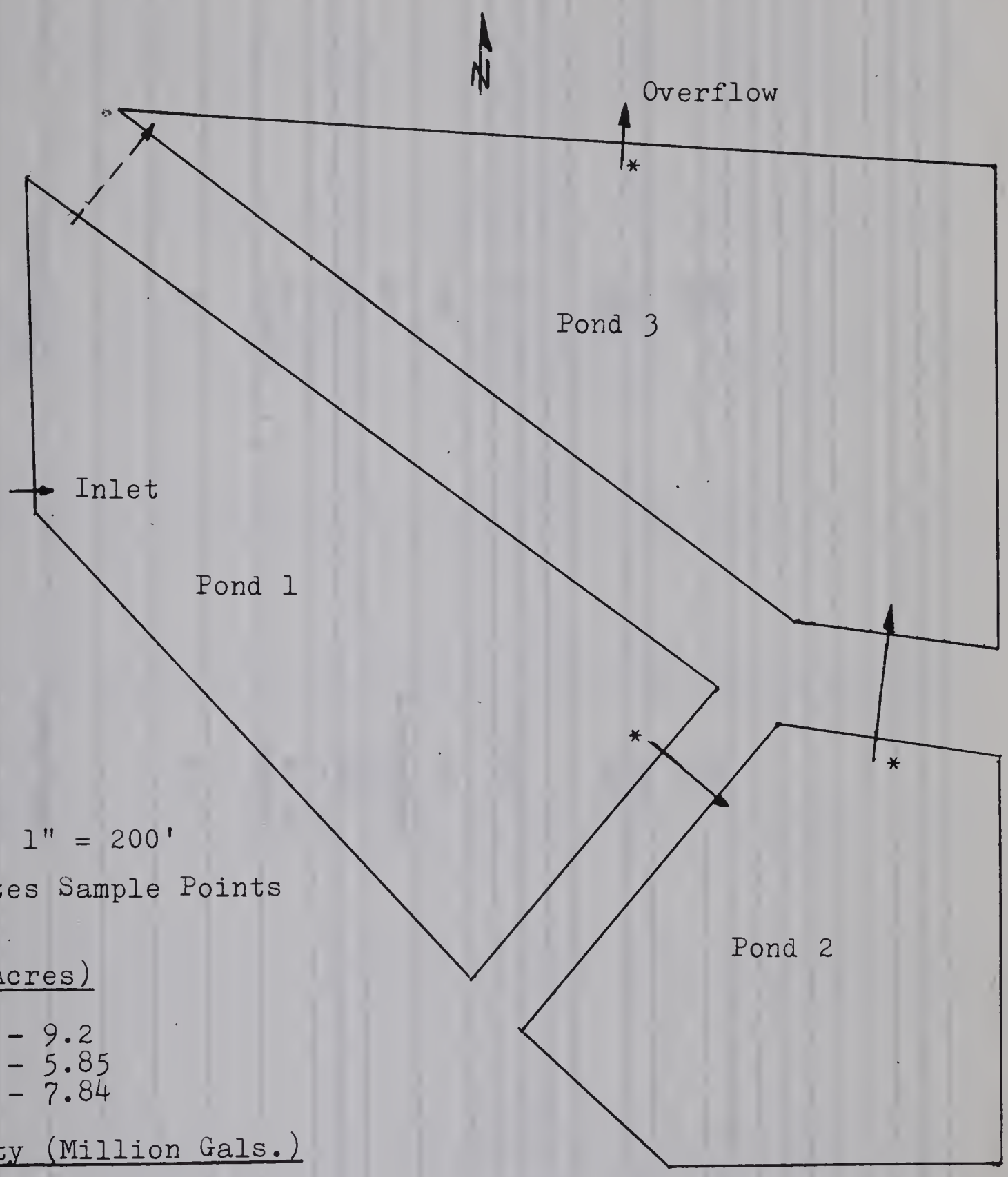
B.O.D., alkalinity, and ammonia nitrogen contents reached their maximum values in the winter, and minimum readings were in the late spring or summer. Generally B.O.D. decreased with detention time, but this was not noticed in the alkalinity or the ammonia-nitrogen contents.

Total solids decreased in the late winter and early spring with increases observed in the early winter.

Dissolved oxygen was present in the three ponds throughout the summer. Some dissolved oxygen was obtained in the third pond as late as November.

The T.O.N. of the liquid in the ponds had their highest value in the winter. Values as high as 5,000 were obtained in the winter of 1961-62. In the general area of the ponds, odors were nil throughout the summer and fall. However, in the spring odors of moderate intensity were detectable near the overflow structures of each pond.

Plan of Drayton Valley Sewage Ponds



Scale: 1" = 200'

* Indicates Sample Points

Area (Acres)

Pond 1 - 9.2
Pond 2 - 5.85
Pond 3 - 7.84

Capacity (Million Gals.)

Pond 1 - 12.5 @ 5' Depth
Pond 2 - 7.95 @ 5' Depth
Pond 3 - 8.53 @ 4' Depth

Table 3A

SEWAGE POND STUDY

Location Drayton Valley Raw Sewage — Sampling Point

		1964 June 10	June 11
Time		8a.m.-8p.m.	8a.m.-8p.m.
Wind, mphr.			
Light, fo.			
pH		7.8	7.8
D.O. ppm			
Temperature °C.		VARIED 12-14	VARIED 12-14
Alkalinity, ppm	pp	-	-
	MO	655	550
Odor, T.O.N.		300 Sewage&Dairy	200
B.O.D., ppm		220	206
Nitrogens, ppm	Total		
	Ammonia	48.0	35
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1334	1216
	Volatile	330	311
Suspended Solids, ppm	Total	228	168
	Volatile	156	126
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet			
Liquid, feet			
Overflow			

Table 3B

SEWAGE POND STUDY

Location Drayton Valley Pond 1 — Sampling Point Outfall of Pond #1

Date		Dec.20/61	Jan.17/62	Feb.14/62	March 14	April 11	May 9	July 11/62	Aug.2/62
Time		11^{10}a.m.	9^{20}a.m.	9^{30}a.m.	945p.m.	950a.m.	9^{10}a.m.	10^{40}a.m.	11^{05}a.m.
Wind, mphr.		calm	5	5	5	calm	5	Calm	10m.p.h.
Light, fo.		700	1000+	1000+	810	1000+	1000+	sunny	sunny
pH		7.6	7.5	7.3	7.4	7.5	7.5	9.1	9.0
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	28	17.0
Temperature °C.		1.0	1.0	1.0	1.0	4.0	11.0	21	19
Alkalinity, ppm	pp	—	--	--	--	--	--	75	65
	MO	850	1115 (oil)	615 (oil)	850	440	525	455	495
Odor, T.O.N.		2000	4800	3000	4000	300	300	--	100
B.O.D., ppm		146	168	156	141	143	108	83	43
Nitrogens, ppm	Total	53.0	73.0	57.0	58.0	35.0	37.0		
	Ammonia	29.0	67.0	58.0	61.5	20.0	21.2	9.5	7.5
	Nitrite	0.004	0.050	NIL	0.010	0.020	NIL		
	Nitrate	0.60	0.689	NIL	NIL	0.063	0.075		
Total Solids ppm	Total	1360	1905	1056	1332	786	875	1178	1195
	Volatile	191	230	165	188	154	142	250	248
Suspended Solids, ppm	Total	42	71	45	22	19	30	118	92
	Volatile	41	46	34	22	19	30	117	54
Chlorides ppm		14	42	40	44	30	40		
Sulfates ppm		235	340	260	292	282	175		
Phosphates ppm		48	73	39	40	48	39		
Detergents ppm		10.5	17.8	8.6	9.5	5.2	4.8		
Ice, feet		1.2	1.5	1.0	2.0	--	--	—	--
Liquid, feet		5.0	3.0	4.0	4.0	--	3.0		
Overflow		No	No	No	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Drayton Valley Pond 1 — Sampling Point Outfall of Pond #1

Date		Nov.21	Jan.3/63	Jan23/63	Mar. 7	April 3	May 22	Dec. 11	Mar. 25
Time		11^{10}a.m.	11^{25}a.m.	11^{30}a.m.	9^{40}a.m.	11^{45}a.m.	12^{35}p.m.	10^{45}	10^{30}a.m.
Wind, mphr.		5	calm	calm	10	calm	10	15	calm
Light, fo.		800	1000+	500	1000+	1000+	1000+	800	1000+
pH		8.0	8.1	7.7	7.7	7.65	7.9	7.4	7.4
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		3	1	0.5	3	4	19	1	1
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	700	780	845	470	530	625	775	780
Odor, T.O.N.		100	2000	2000	petro 3000	1500	500	1000	400
B.O.D., ppm		68	158	176	109	132	56	124	186
Nitrogens, ppm	Total Ammonia	19.5	44.5	36	26.5	28.8	26	38	40.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1234	1169	1119	1026	953	988	845	1311
	Volatile	225	162	156	218	150	148	186	178
Suspended Solids, ppm	Total	136	46	29	156	45	96	54	50
	Volatile	128	44	21	82	30	96	50	48
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		0.1	1½'	1.5	2	1'		0.5	2.0
Liquid, feet			1'						
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3C

SEWAGE POND STUDY

Location Drayton Valley Pond 2 — Sampling Point Outfall of Pond 2

Date		Dec 20	Jan.17/62	Feb. 14	March 14	April 11	May 9	July 11/62	Aug.2/62
Time		11[15] a.m.	9[30] a.m.	9[50] a.m.	9[50] a.m.	9[40] a.m.	9[20] a.m.	10[30] a.m.	11[00] a.m.
Wind, mphr.		calm	5	5	5	calm	5	calm	10
Light, fo.		720	1000+	1000+	810	1000+	1000+	sunny	sunny
pH		8.4	8.1	7.8	8.0	7.0	7.8	9.0	9.75
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	20	18
Temperature °C.		0.5	0.5	0.5	0.2	0.5	11.0	21	23
Alkalinity, ppm	pp	5	--	--	--	--	--	45	135
	MO	990	1020	1205	1480	50	600	560	425
Odor, T.O.N.		1200	3600	2000	3000	10	100	--	6 sewage musty
B.O.D., ppm		23	28	65	35	5	36	34	25
Nitrogens, ppm	Total	38.6	32.0	47.0	47.6	18.8	28.0		
	Ammonia	8.5	30.0	44.0	42.0	21.5	16.0	9.0	18.5
	Nitrite	0.007	0.050	NIL	NIL	0.020	NIL		
	Nitrate	0.59	0.602	0.018	NIL	0.070	0.075		
Total Solids ppm	Total	1620	1660	1820	2096	98	933	1084	1148
	Volatile	160	153	164	189	40	131	217	215
Suspended Solids, ppm	Total	26	24	54	45	68	31	65	24
	Volatile	26	24	36	45	68	31	65	6
Chlorides ppm		66	48	54	60	12	36		
Sulfates ppm		260	275	390	297	270	170		
Phosphates ppm		59	68	81	85	2.3	41.0		
Detergents ppm		6.0	8.0	10.3	10.6	NIL	5.0		
Ice, feet		1.25	1.0	1.5	2.0	--	--	--	--
Liquid, feet		3.0	4.0	4.0	4.0	1.5	3.0	8"	8"
Overflow		No	No	No	No	↑ Pump Sample	Yes	Yes	Yes

SEWAGE POND STUDY

Location Drayton Valley Pond 2 — Sampling Point Outfall of Pond 2

Date		Nov.21	Jan.3/63	Jan.23/63	Mar. 7	April 3	May 22	Dec. 11	Mar.25/64
Time		11^{00}a.m.	11^{10}a.m.	11^{45}a.m.	9^{50}a.m.	11^{30}a.m.	12^{30}p.m.	11^{00}	1045a.m.
Wind, mphr.		5	calm	calm	10	calm	10	15	calm
Light, fo.		800	1000+	500	1000+	1000+	1000+	800	1000+
pH		7.95	8.25	7.8	7.6	7.6	7.9	7.5	7.5
D.O. ppm		NIL	NIL	NIL	NIL	NIL	1.8	NIL	NIL
Temperature ^{c}C.		2	0.5	0.5	2	3	13	1	1
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	640	905	930	415	500	465	790	855
Odor, T.O.N.		10	1000	1200	1000	500	300	600	200
B.O.D., ppm		44	108	169	93	103	26	80	181
Nitrogens, ppm	Total Ammonia	14.5	44.5	38.5	24.0	26.5	10	31.5	40.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1176	1273	1242	804	903	828	1199	1370
	Volatile	171	155	158	170	152	175	689	176
Suspended Solids, ppm	Total	72	40	33	126	45	170	50	46
	Volatile	60	40	28	80	20	160	50	44
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		2"	2.0	2.5	2	2'		0.5	2.0
Liquid, feet		8"	1'					Yes	Yes
Overflow		yes	Yes	Yes	Yes				

Table 3D

SEWAGE POND STUDY

Location Drayton Valley Pond 3 — Sampling Point Outfall of Pond 3

Date		Dec. 20	Jan. 17/62	Feb. 14	March 14	April 11	May 9	July11/62	Aug.2/62
Time		11^{25} AM	9^{30}a.m.	1015a.m.	10^{05}a.m.	10^{15}a.m.	9^{35}a.m.	10^{20}a.m.	10^{30}a.m.
Wind, mphr.		Calm	5	5	5	Calm	5	Calm	10
Light, fo.		700	1000+	1000+	810	1000+	1000+	Sunny	Sunny
pH		7.9	7.6	7.4	7.5	7.5	7.7	8.95	9.0
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	1.2	2.0
Temperature °C.		0.5	0.5	0.2	0.5	0.3	10.0	21	18
Alkalinity, ppm	pp	--	--	--	--	--	--	40	55
	MO	920	765	720	720	250	410	435	540
Odor, T.O.N.		1000	5000	4000	(oil) 3000	1000	200	—	6 sewage
B.O.D., ppm		84	107	130	115	25	28	15	16
Nitrogens, ppm	Total	38.6	47.0	57.0	50.8	11.2	17.9		
	Ammonia	18.0	21.1	58.0	52.5	8.5	12.2	5.5	3.5
	Nitrite	0.001	0.003	NIL	0.012	0.010	NIL		
	Nitrate	NIL	0.415	NIL	NIL	0.088	0.080		
Total Solids ppm	Total	1484	1276	1164	1127	515	695	891	976
	Volatile	177	168	171	159	139	241	130	139
Suspended Solids, ppm	Total	20	20	59	52	26	29	6	74
	Volatile	20	20	48	52	15	29	6	44
Chlorides ppm		48	24	28	48	10	26		
Sulfates ppm		231	212	300	243	290	165		
Phosphates ppm		50	45	47	45	28	29		
Detergents ppm		10	10.4	12.6	9.1	3.0	2.3		
Ice, feet		1.5	1.5	2.0	2.0	1.5	--	--	--
Liquid, feet		3.0	3.0	3.0	3.0	1.0	3.0	--	--
Overflow		No	No	No	No		NO	Yes	Yes

SEWAGE POND STUDY

Location Drayton Valley Pond 3 — Sampling Point Outfall of Pond 3

Date		Nov. 21	Jan.3/63	Jan.23/63	Mar. 7	April 3	May 22	Dec. 11	Mar.25/64
Time		1045 a.m.	1055	1200 Noon	1010 a.m.	1110 a.m.	1215	1110	1100 a.m.
Wind, mphr.		5	Calm	Calm	10	Calm	10	15	Calm
Light, fo.		800	1000+	500	1000 +	1000 +	1000+	800	1000 +
pH		9.2	8.6	8.05	7.75	7.7	8.85	8.1	7.6
D.O. ppm		3.0	NIL	NIL	NIL	NIL	29.8	NIL	NIL
Temperature °C.		2	1	0.5	1.5	3	19	1	0.5
Alkalinity, ppm	pp	85	35	—	—	—	25	—	—
	MO	540	910	1090	645	490	475	755	975
Odor, T.O.N.		4 Musty	1000	800	1000	300	20	200	200
B.O.D., ppm		22	60	102	104	96	27	57	174
Nitrogens, ppm	Total Ammonia	6.25	32.3	38	33	25.8	11.5	18.5	42.0
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1124	1339	1396	1044	783	784	1314	1516
	Volatile	162	151	155	159	162	118	187	195
Suspended Solids, ppm	Total	148	52	60	88	39	92	54	36
	Volatile	112	50	30	66	22	88	50	32
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		2"	2'	2.5	2.5	2.0		0.5	2.0
Liquid, feet			2½'						
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

B.O.D.

PPM

200
150
100
50

Odor

T.O.N.

4000
3000
2000
1000

Pond 1
Pond 2
Pond 3

Alkalinity

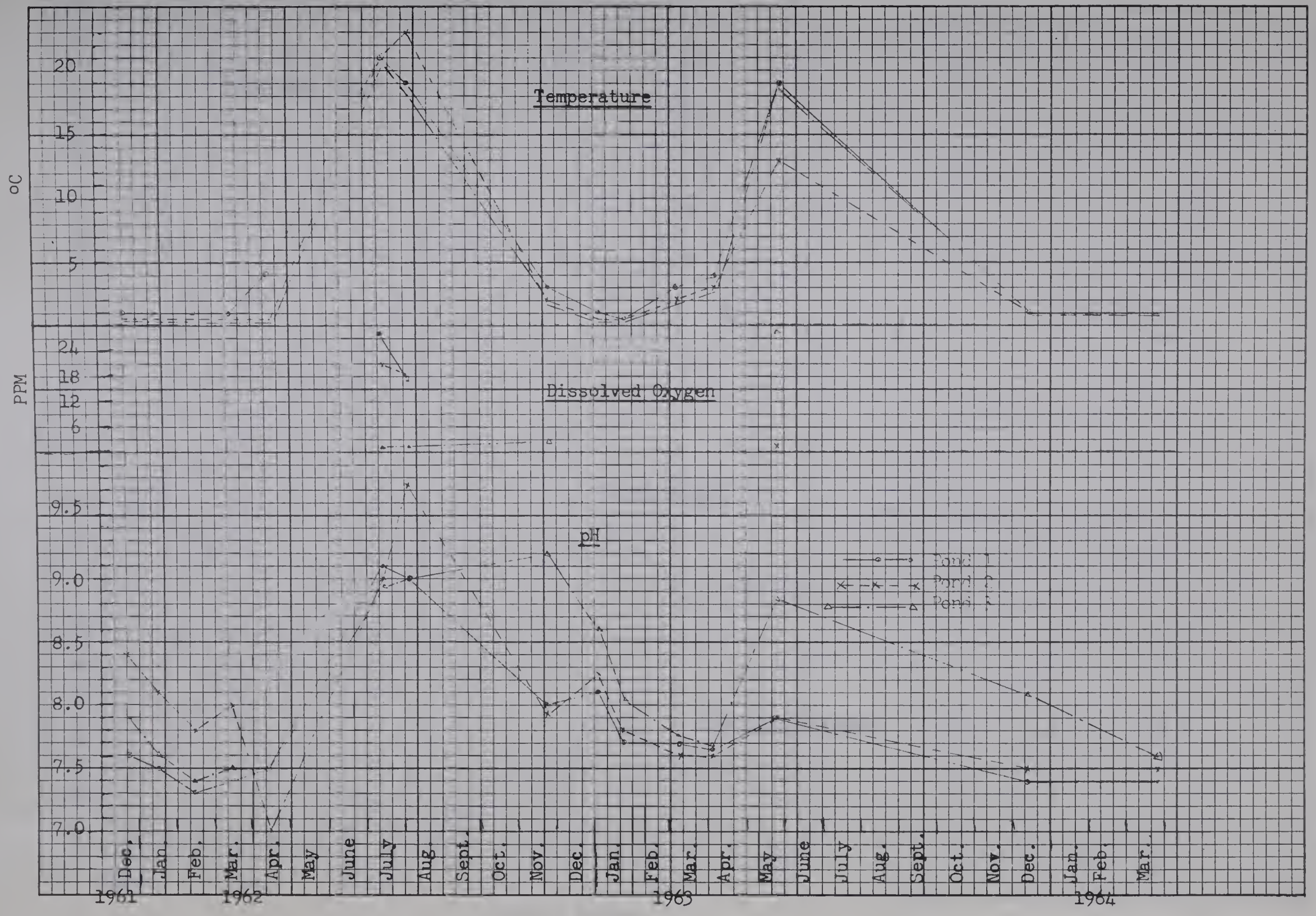
PPM

1600
1400
1200
1000
800
600
400

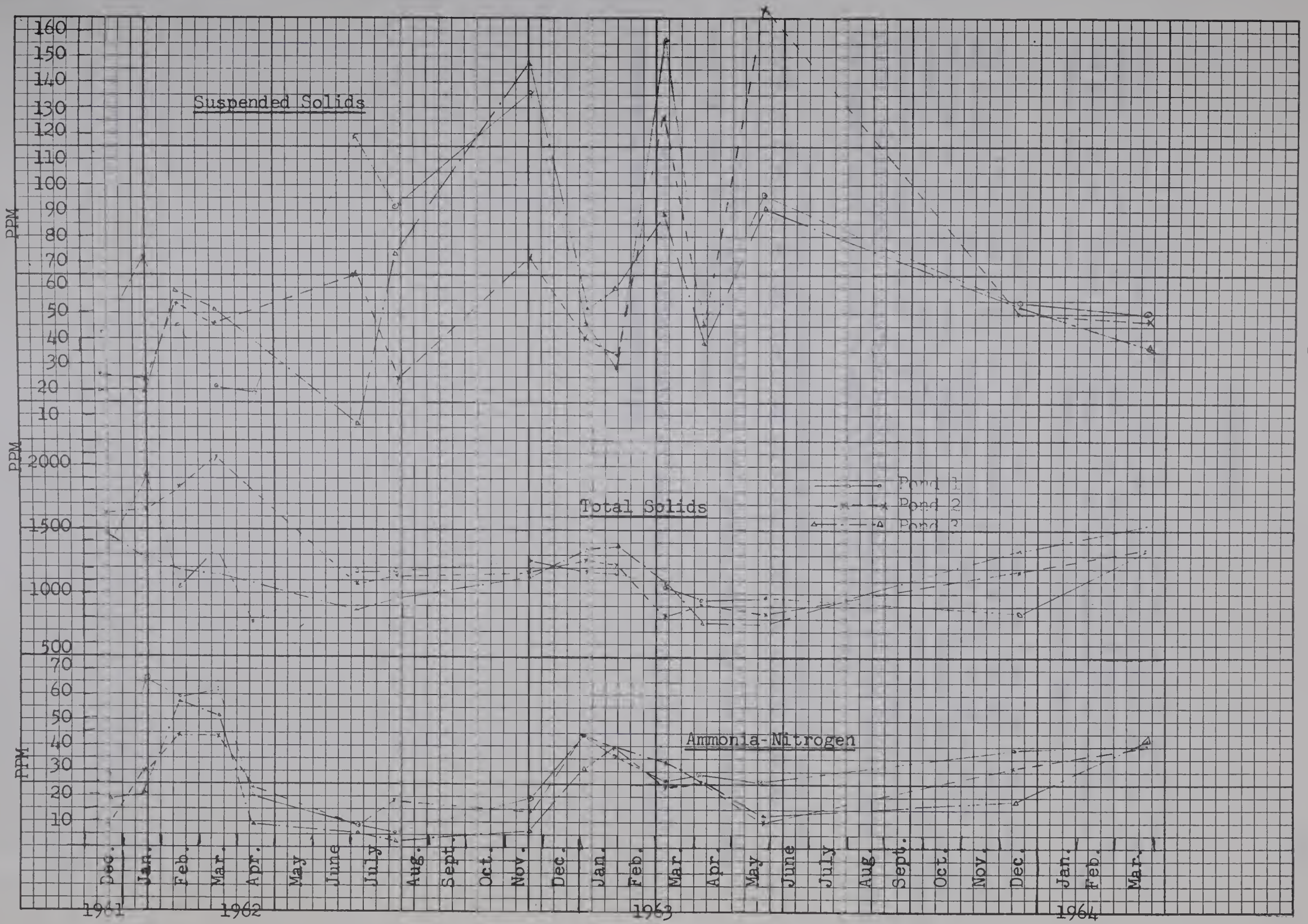
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1961 1962 1963 1964

Drayton Valley



Drayton Valley



Drayton Valley

DRUMHELLER

The Drumheller sewage system, consisting of four short detention ponds, serves a population of 3,156 and the usual business places. The system is operated in series with the effluent being discharged to the Red Deer River. Three grab samples from the ponds and two composite raw sewage samples were obtained during the investigation period.

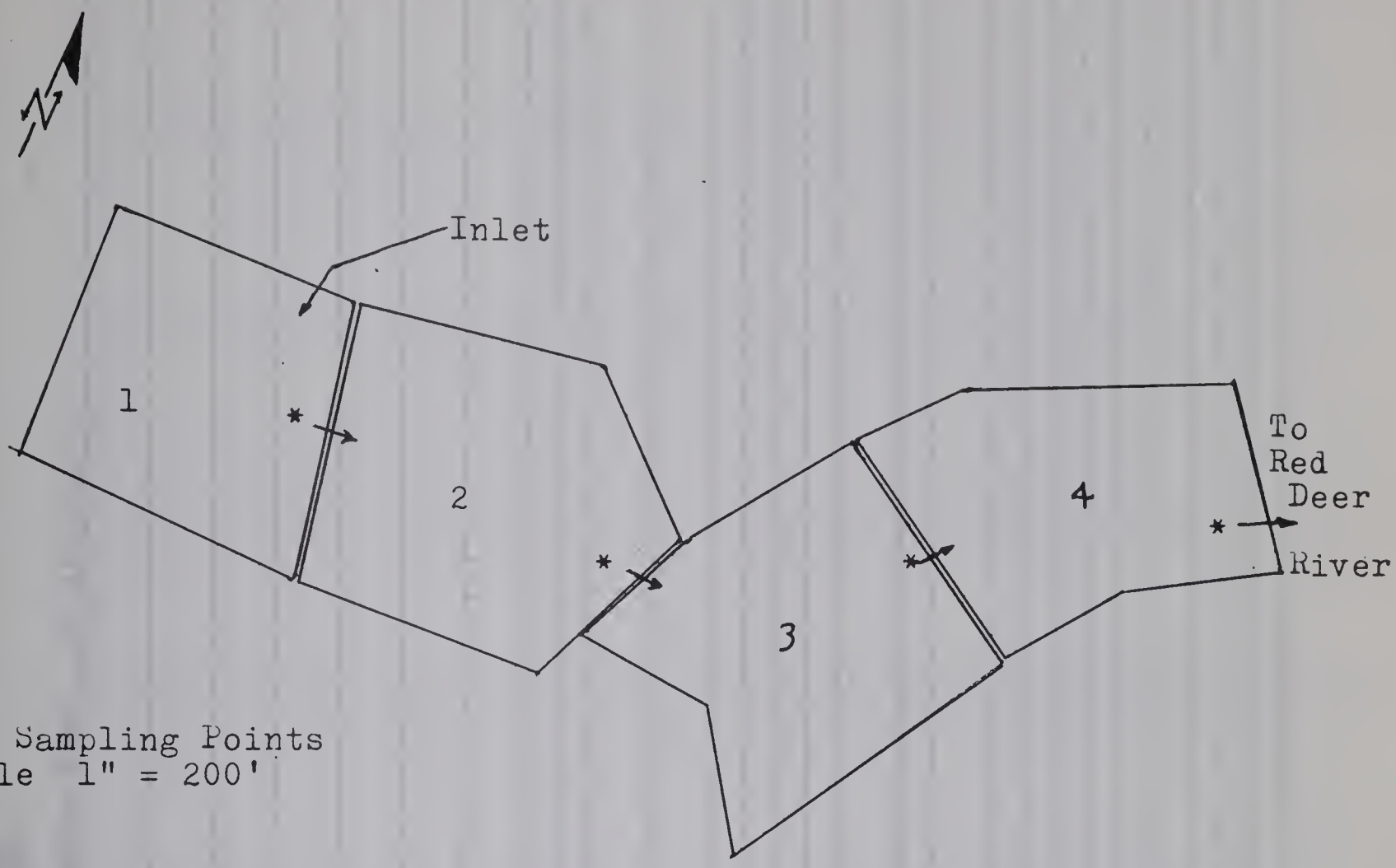
The efficiency of the system as computed from the three samples was 62.3% reduction in B.O.D. Considering the July 10, 1963 sample as summer conditions, the B.O.D. reduction was a very high 91.0% of which 61.4% occurred in the first pond. Samples on this date showed dissolved oxygen presence in the third and fourth ponds. A spot check on June 3, 1964 indicated dissolved oxygen content of 9.2 ppm and 17.2 ppm in the third and fourth ponds. respectively. Aerobic conditions existing in the fourth pond during the summer have provided an additional 15.4% treatment.

The winter efficiency using samples of February 5, 1963 and March 4, 1964, is 47.8% reduction in B.O.D. for the entire system.

At the time of visits to the ponds, odors in the general area were of very low concentration.

With the limited number of samples trends for the chemical components can not be established.

Plan of Drumheller Ponds



* - Sampling Points
Scale 1" = 200'

Capacity of Ponds (Million Gals.)

#1 - 1.46 @ 7' Depth
2 - 1.55 @ 7' Depth
3 - 1.37 @ 7' Depth
4 - 1.41 @ 7' Depth

Area (Acres)

Pond 1 - 0.74
2 - 0.81
3 - 0.70
4 - 0.73

Figure 6

Table 4A

SEWAGE POND STUDY

Location Drumheller Raw Sewage **Sampling Point** At lift Station

Date		Feb.5/63	June 3/64					
Time		8a.m. - 4p.m.	8a.m. - 8p.m.					
Wind, mphr.								
Light, fo.								
pH		7.4	7.25					
D.O. ppm								
Temperature °C.								
Alkalinity, ppm	pp	--	--					
	MO	335	305					
Odor, T.O.N.		400	100					
B.O.D., ppm		310	252					
Nitrogens, ppm	Total Ammonia	52.5	46.8					
	Nitrite							
	Nitrate							
Total Solids ppm	Total	777	894					
	Volatile	305	445					
Suspended Solids, ppm	Total	344	176					
	Volatile	268	156					
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet								
Liquid, feet								
Overflow								

Table 4B

SEWAGE POND STUDY

Location Drumheller No. 1 Sampling Point Outfall P nd Number One

Date		Feb 5/63	July 10/63	Mar. 4/64					
Time		3^{20} p.m.	8^{15} a.m.	11^{45} a.m.					
Wind, mphr.		Calm	Calm	Calm					
Light, fo.		800	1000 +	1000 +					
pH		7.5	7.5	7.4					
D.O. ppm		NIL	NIL	NIL					
Temperature °C.		1	19	3					
Alkalinity, ppm	pp	--	—	—					
	MO	320	335	335					
Odor, T.O.N.		2000	2000	200					
B.O.D., ppm		216	109	223					
Nitrogens, ppm	Total Ammonia	39	24.5	40.8					
	Nitrite								
	Nitrate								
Total Solids ppm	Total	636	688	692					
	Volatile	206	239	231					
Suspended Solids, ppm	Total	80	144	75					
	Volatile	54	120	60					
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color			Green						
Ice, feet		0.5		—					
Liquid, feet									
Overflow		Yes	Yes	Yes					

Table 4C

SEWAGE POND STUDY

Location: Drumheller No. 2 — Sampling Point: Outfall of Pond No. 2

Date		Feb. 5/63	July 10/63	March 4/64
Time		2:30 pm	8:20 am	11:55 am
Wind, mphr.		Calm	Calm	Calm
Light, fo.		800	1000+	1000+
pH		7.5	7.55	7.3
D.O. ppm		Nil	Nil	Nil
Temperature °C.		1	19	1
Alkalinity, ppm	pp	-	-	-
	MO	335	325	265
Odor, T.O.N.		1000	2000	100
B.O.D., ppm		185	67	208
Nitrogens, ppm	Total Ammonia	46.5	25.5	39.5
	Nitrite			
	Nitrate			
Total Solids ppm	Total	624	640	648
	Volatile	215	210	208
Suspended Solids, ppm	Total	54	84	98
	Volatile	40	84	58
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Color			Green	
Ice, feet		0.8		0.5
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 4D

SEWAGE POND STUDY

Location Drumheller No.3 Sampling Point Outfall of Pond No. 3

Date		Feb. 5/63	July 10	Mar. 4/64
Time		3:40 pm	8:25 am	12:15 pm
Wind, mphr.		Calm	Calm	Calm
Light, fo.		800	1000+	1000+
pH		7.6	7.85	7.3
D.O. ppm		Nil	0.8	Nil
Temperature °C.		1	19	1
Alkalinity, ppm	pp	-	-	-
	MO	285	290	265
Odor, T.O.N.		800	800	200
B.O.D., ppm		191	66	119
Nitrogens, ppm	Total			
	Ammonia	55	22	33.5
	Nitrite			
	Nitrate			
Total Solids ppm	Total	668	588	493
	Volatile	213	171	143
Suspended Solids, ppm	Total	35	68	32
	Volatile	26	58	26
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Color			Green	
Ice, feet		2.0		1.5
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 4E

SEWAGE POND STUDY

Location Drumheller No. 4 **Sampling Point** Outfall of Pond No. 4

Date		Feb. 5/63	July 10	Mar. 4/64
Time		3:50 p.m.	8:35 a.m.	12:30 p.m.
Wind, mphr.		Calm	Calm	Calm
Light, fo.		800	1000+	1000+
pH		7.6	8.3	7.2
D.O. ppm		Nil	6.5	Nil
Temperature °C.		1	19	1
Alkalinity, ppm MO pp		-	-	-
		405	300	255
Odor, T.O.N.		400	100	100
B.O.D., ppm		179	25	114
Nitrogens, ppm	Total			
	Ammonia	60.6	22	30.8
	Nitrite			
	Nitrate			
Total Solids ppm	Total	674	550	463
	Volatile	214	132	141
Suspended Solids, ppm	Total	49	50	22
	Volatile	36	36	18
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Color			Light green	
Ice, feet		2.5		1.5
Liquid, feet				
Overflow		Yes	Yes	Yes

EVANSBURG

The Village of Evansburg is served by a system of two short detention and two long detention ponds in series. Sewage is collected from a population of 500 and a creamery, and is pumped (sewage passes through a comminutor) to the lagoons. The creamery produces butter and processes milk with the wastes consisting of cooling and wash water, and skim milk.

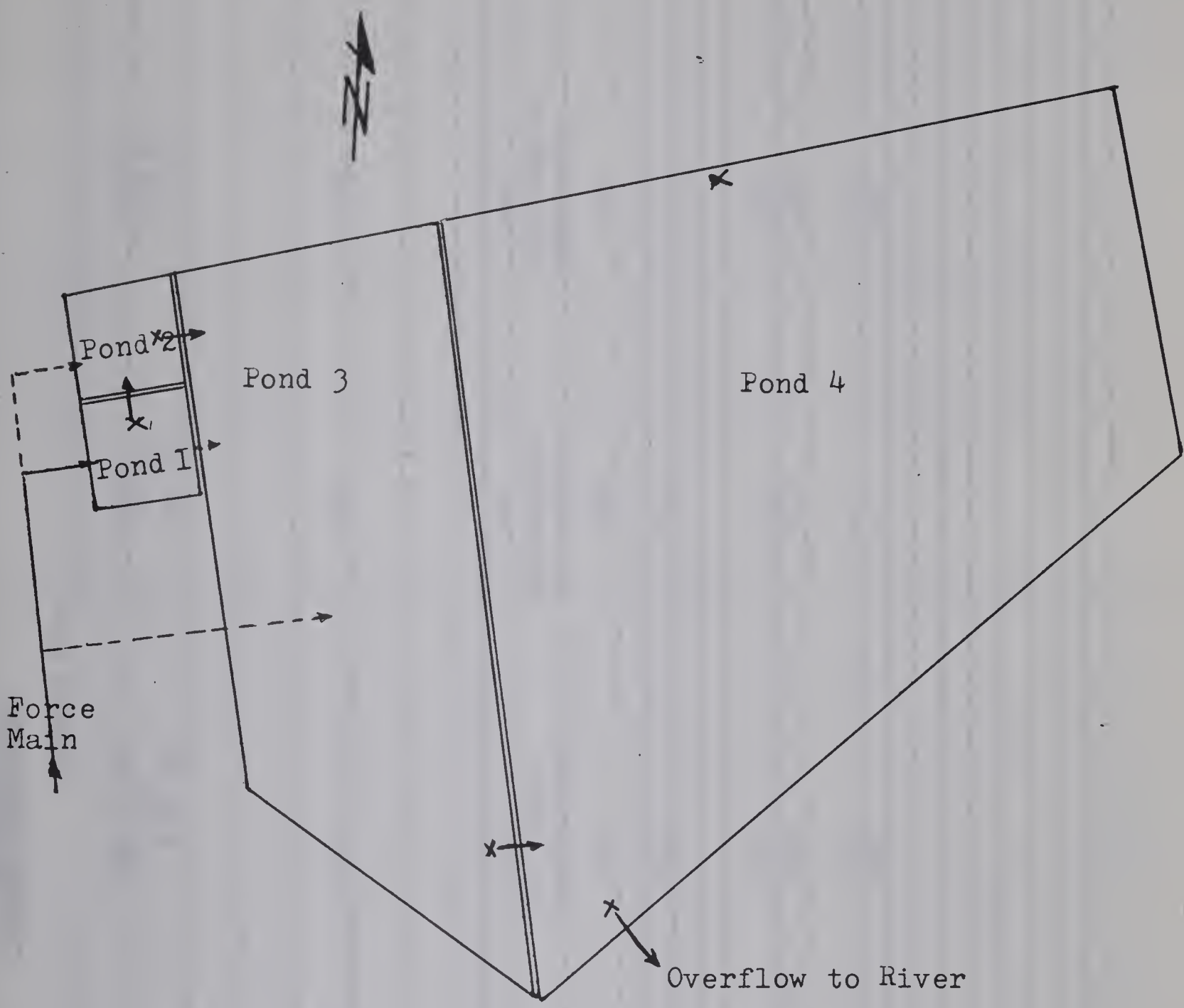
The creamery which dumps a large quantity of skim milk into the system has heavily overloaded the ponds. This overloading has caused offensive odors of high intensity to develop from the short detention and first long detention ponds during the open water periods. B.O.D. load on the first short detention pond was 25,300 lb/acre/day or 58.0 lbs/1000ft3/ day which is much higher than the allowable 4,000 lb/acre/day for anaerobic ponds. The winter performance of the first short detention cell was 39.7% B.O.D. reduction, and 64.6% reduction in suspended solids while the summer performance was 54.0% for B.O.D. and 23.1% for suspended solids. However, the B.O.D. and suspended solids in the second short detention ponds increased giving a "negative" performance throughout the year.

It is difficult to assess what physical or chemical aspects, other than the type of waste, have caused the second short detention pond to turn "sour". Throughout the year the liquid in both short detention ponds had a very black or a green-black color. During the open water seasons the surface of both short detention ponds were covered with black material similar in appearance to sludge. The suspended solids contents were exceptionally high due to the floating material. In the first short detention pond suspended solids reduction was 26.8% while an increase of 23.5% was noted in the second short detention pond.

All three composite raw sewage sampled had a pH below 7.0 (acidic) and a dairy waste odor. During the period of April 1963 to September 1963, hydrated lime at the rate of 7 pounds per 40,000 gallons of sewage per day was added to the raw sewage. The lime, as indicated by the pH readings (see figure 8), was practical to some degree as it kept the pH of the first short detention pond near or above neutral. However, the pH of the second short detention pond was generally lower than in the first, indicating the lime was only effective in the first cell. Although the pH was corrected to proper anaerobic conditions the odor problem was not alleviated. The lime was discontinued after freeze-up and hence resulted in acidic pH readings in both short detention cells during the winter.

The long detention ponds have certainly provided a high degree of treatment despite the "sour" conditions in the anaerobic (short detention) ponds. Overall efficiency for the entire system was 96.0% B.O.D. reduction in the winter and 90.8% in the summer.

Plan of Evansburg Lagoons



Scale 1" = 100'
x - Sample Locations
→ - Flow During Investigation Period
---→ Alternate Flow Routes

Volume

Pond #1 - 67,300 Gal. @ 8' Depth
#2 - 67,300 Gal. @ 8' Depth
#3 - 1.4 million Gal. @ 6' Depth
#4 - 4.4 Million Gal. @ 6' Depth

Area

Pond 1 - 0.03 Acres
2 - 0.03 Acres
3 - 1.13 Acres
4 - 3.02 Acres

Figure 7

Table 5A

SEWAGE POND STUDY

Location Evansburg Raw Sewage Sampling Point

Date		Aug. 30/63	May 26/64	May 27	May 28
Time		8:30 am	12 noon - 8:00 pm	8:00 am - 8:00 pm	8:00 am - 8:00 pm
Wind, mphr.					
Light, fo.					
pH	Field	8.7			
	Lab.	8.45	6.7	6.15	6.2
D.O. ppm					
Temperature °C.					
Alkalinity, ppm	pp	90	-	--	-
	MO	373	195	185	250
Odor, T.O.N.		1500 S & Creamery	1000 sewage & dairy wastes	100 sewage & dairy waste	200 sewage & dairy waste
B.O.D., ppm		670	616	1580	1453
Nitrogens, ppm	Total Ammonia	14.8	24.5	43.0	42.0
	Nitrite				
	Nitrate				
Total Solids ppm	Total	2705	972	1743	1666
	Volatile	2142	570	1312	1202
Suspended Solids, ppm	Total	1092	356	200	576
	Volatile	1080	304	152	528
Chlorides ppm		50			
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet					
Liquid, feet					
Overflow					
Remarks		Grab SAMPLE			

Table 5B

SEWAGE POND STUDY

Location: Evansburg #1 — Sampling Point: #1 Short Detention

Date		Aug. 30/62	May 16/63	May 22	June 20	July 2	July 22	July 24	Dec. 11
Time			11:00 am	11:25 am	3:20 pm				12:45 pm
Wind, mphr.			30	5	Calm				30
Light, fo.			Cloudy	1000+	Cloudy				800
pH	Field	6.3			6.15				
	Lab	6.3	6.9	7.0	6.4	7.0		6.9	6.4
D.O. ppm		Nil	Nil	Nil	Nil				Nil
Temperature °C.		12	11	19	19				1
Alkalinity, ppm	pp	–	–	–	–			–	–
	MO	450	395	350	445			480	690
Odor, T.O.N.		5000	900	800	5000	3000		7000 creamery pig pen	7000 pigpen
B.O.D., ppm		750	543	426	>710	593	418	442	648
Nitrogens, ppm	Total Ammonia	45.1	25.5	16	55			41	78
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1158	1045	1071	1363			1083	1221
	Volatile	663	550	559	777			545	519
Suspended Solids, ppm	Total	264	352	430	282			270	114
	Volatile	252	312	225	282			260	104
Chlorides ppm		60							
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet									
Liquid, feet									0.2
Overflow			Yes	Yes	Yes			Yes	Yes
Color and remarks			Green	Greenish Black					

SEWAGE POND STUDY

Location: Evansburg #1 — Sampling Point: #1 Short Detention

Date		Mar. 25/64	June 17/64
Time		12:15 pm	
Wind, mphr.		Calm	
Light, fo.		1000+	
pH		6.6	6.9
D.O. ppm		Nil	-
Temperature °C.		1	-
Alkalinity, ppm	pp	-	-
	MO	715	655
Odor, T.O.N.		5000 pig pen	4000 pig pen
B.O.D., ppm		807	443
Nitrogens, ppm	Total		
	Ammonia	75	105
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1412	
	Volatile	674	
Suspended Solids, ppm	Total	152	344
	Volatile	150	180
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		0.5	
Liquid, feet			
Overflow		Yes	Yes
Color and Remarks			Green Black

Table 50

SEWAGE POND STUDY

Location Evansburg #2 — Sampling Point Overflow at Pond #2

Date		Aug.30/62	May 16/63	May 22	June 20	July 2	July 22	July 24	Dec.11/63
Time		8:30a.m.	11:10a.m.	11:20a.m.	3:15p.m.				12:50 p.m
Wind, mphr.			30	5	Calm				30
Light, fo.			Cloudy	1000+	Cloudy				800
pH	Fn / Lab.	6.25 / 6.30	6.8	6.4	6.25 / 6.40	6.9		6.95	6.5
D.O. ppm		NIL	NIL	NIL	NIL				NIL
Temperature °C.		13	11	19	19				1
Alkalinity, ppm	pp	--	--	--	--			--	--
	MO	345	365	465	440			440	625
Odor, T.O.N.		2000	600	1100	3000	5000		1500 Pig Pen	4000
B.O.D., ppm		730	670	> 1000	> 1000	781	315	510	692
Nitrogens, ppm	Total Ammonia	44.6	38.5	47.0	58.6			38	57.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1101	1193	1346	1296			1031	1218
	Volatile	650	672	791	673			521	547
Suspended Solids, ppm	Total	230	416	400	280			300	186
	Volatile	228	384	390	276			300	180
Chlorides ppm		15							
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet									0.2
Liquid, feet									
Overflow			Yes	Yes	Yes			Yes	Yes

SEWAGE POND STUDY

Location Svensburg 2 Sampling Point Overflow At Pond #2

Date		Mar.25/64	June 17/64
Time		1½:30p.m.	
Wind, mphr.		Calm	
Light, fo.		1000+	
pH		6.5	6.8
D.O. ppm		NIL	
Temperature °C.		1	
Alkalinity, ppm	pp	--	--
	MO	500	430
Odor, T.O.N.		1000	5000 Pig Pen
B.O.D., ppm		1090	480
Nitrogens, ppm	Total Ammonia	51.0	77.5
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1621	--
	Volatile	955	--
Suspended Solids, ppm	Total	380	428
	Volatile	376	260
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		0.5	--
Liquid, feet			
Overflow		Yes	Yes

Table 5D

SEWAGE POND STUDY

Location Evansburg #1 (Long Detention) Sampling Point At Outfall

Date		Aug.30/62	May 19/63	May 22/63	June 20	July 2	July 22	July 24	Dec. 11
Time		9:00a.m.	11:15a.m.	11:10a.m.	3:00p.m.				1:00p.m.
Wind, mphr.			30	5	Calm				30
Light, fo.			Cloudy	1000+	cloudy				800
pH	FIELD	7.1			7.15				
	Lab.	7.15	7.15	7.15	7.05	7.3		7.45	6.6
D.O. ppm		NIL	--	--	NIL				NIL
Temperature °C.		13	11	19	19				1
Alkalinity, ppm	pp	--	--	--	--			--	--
	MO	335	315	325	420			500	665
Odor, T.O.N.		400	800	1000	700	500		600	2000
B.O.D., ppm		228	335	337	~~7350~~ > 350	~~7345~~ > 345	228	190	335
Nitrogens, ppm	Total Ammonia	16.5	31	27	25			29	54
	Nitrite								
	Nitrate								
Total Solids ppm	Total	703	677	705	1037			1042	1196
	Volatile	314	349	370	560			491	527
Suspended Solids, ppm	Total	92	208	320	400			300	220
	Volatile	88	204	310	392			296	212
Chlorides ppm		50							
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet									0.5
Liquid, feet									3.0
Overflow				No				Yes	Yes

SEWAGE POND STUDY

Location Evansburg 3/4 Sampling Point At Outfall

Date		Mar.25/64	June 17/64
Time		12:45p.m.	
Wind, mphr.		Calm	
Light, fo.		1000+	
pH		6.45	7.2
D.O. ppm		NIL	
Temperature °C.		1	
Alkalinity, ppm	pp	--	--
	MO	775	525
Odor, T.O.N.		2000	400
B.O.D., ppm		864	445
Nitrogens, ppm	Total		
	Ammonia	75.0	47.5
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1430	--
	Volatile	680	--
Suspended Solids, ppm	Total	132	372
	Volatile	124	364
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		2.0	--
Liquid, feet		3.5	
Overflow		Yes	Yes

Table 5E

SEWAGE POND STUDY

Location Evansburg #4 (long detention) Sampling Point At outfall to River

Date		Aug. 30/62	May 16/63	May 22	June 20	July 24	Dec. 11	Mar. 25/64	June 17
Time		9:00 am	11:20 am	11:00 am	3:05 pm	—	1:10 pm	1:00 pm	
Wind, mphr.			30	5	Calm		30	Calm	
Light, fo.			Cloudy	1000+	Cloudy		800	1000+	
pH	Field	8.7			7.55				
	Lab.	8.5	10.5	10.3	7.4	8.15	7.8	7.4	7.95
D.O. ppm		10.65	13	23.4	1.8	14	0.6	Nil	—
Temperature °C.		13	11	19	19		1	1	
Alkalinity, ppm	pp	10	-	-	-	-	-	-	-
	MO	275	total 105	total 100	240	305	435	640	500
Odor, T.O.N.		10	20	30	40 grassy	20 grassy	10 grassy	100 grassy	10 grassy
B.O.D., ppm		55	68	91	57	145	13	88	173
Nitrogens, ppm	Total Ammonia	4	6	6.5	10	9.5	9.5	20	15
	Nitrite								
	Nitrate								
Total Solids ppm	Total	586	382	363	516	801	685	1022	-
	Volatile	263	246	245	254	454	219	311	-
Suspended Solids, ppm	Total	61	256	290	56	188	30	94	260
	Volatile	53	204	250	52	184	28	58	250
Chlorides ppm		30							
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet							0.5	2.0	-
Liquid, feet							3.0	3.5	
Overflow			No	No	No	No	No	No	No
Color and Remarks			Green	Green			Clear	Yellow Green	Yellow Green

-EVANSBURG SEWAGE PONDS- pH READINGS

APRIL 1963 | MAY | JUNE | JULY | AUGUST | SEPTEMBER

5 10 15 20 25

11.0
10.0
9.0
8.0
7.0
6.0

LONG DETENTION PONDS

#4
#3

SHORT DETENTION PONDS

#1
#2

Figure 3

INNISFAIL

The Innisfail system, with a total of four short detention and two long detention ponds, has been in operation since the fall of 1960. The short detention cells, each 0.16 acres in area and 10 feet deep, can be operated either in parallel or series. During the investigation period, either two or three of the short detention cells along with the long detention ponds were operated in series. Throughout the winter of 1961-1962 the final long detention pond was drained sporadically. After the winter of 1962 this pond has been operated with a continuous overflow during the summer and drained in the fall for winter storage.

The system serves a population of about 2,600 and a creamery which produces about 453,000 lb. of butter and 839,000 lb. of milk annually. The waste from the creamery comprises mainly of wash and cooling water.

B.O.D. analysis showed the overall efficiency during the winter for a two pond anaerobic system was 40.0% and 30.1% for three short detention ponds. During the summer the anaerobic pond efficiencies were approximately the same; 43.9% B.O.D. reduction for two ponds and 44.6% for three ponds.

With the addition of the two long detention ponds to the two anaerobic cells, the performance of the entire system was 82.4% B.O.D. reduction in the winter and 95.0% in the summer. The combination of three short detention and two long detention ponds had a lower efficiency; 62.5% B.O.D. reduction during the winter and 89.1% in the summer. However, it should be realized the winter operations for the two types of set-ups were not the same. Throughout the winter of 1961-1962, using two short and two long detention ponds in series, dissolved oxygen was present in the final long detention pond. In the winter of 1962-1963 with no overflow from the second long detention pond the dissolved oxygen disappeared in late December. The liquid in the final long detention pond had a green color till the end of December indicating the presence of some algae. Dissolved oxygen content at this time was 8.0 ppm. On January 13, 1963 when a hole was bored through the two foot thick ice green particles were imbedded in the ice and the liquid was clear indicating that algae had died off. No dissolved oxygen was present in the pond.

The pH values of the liquid in the short detention cells were in a range of 7.0 to 7.7 and no definite trends were established. Except for the winter of 1961-1962, the maximum pH readings in the long detention ponds were in the summer.

Ammonia-nitrogen content, both in the short and long detention ponds, usually reached their peak values in the winter and minimas in the summer. A general decrease in the ammonia-nitrogen concentration, particularly during the summer, occurred with detention time.

Total solids showed no definite trends either in the short detention or in the long detention ponds except in the final long detention pond where maximum readings were obtained in the winter.

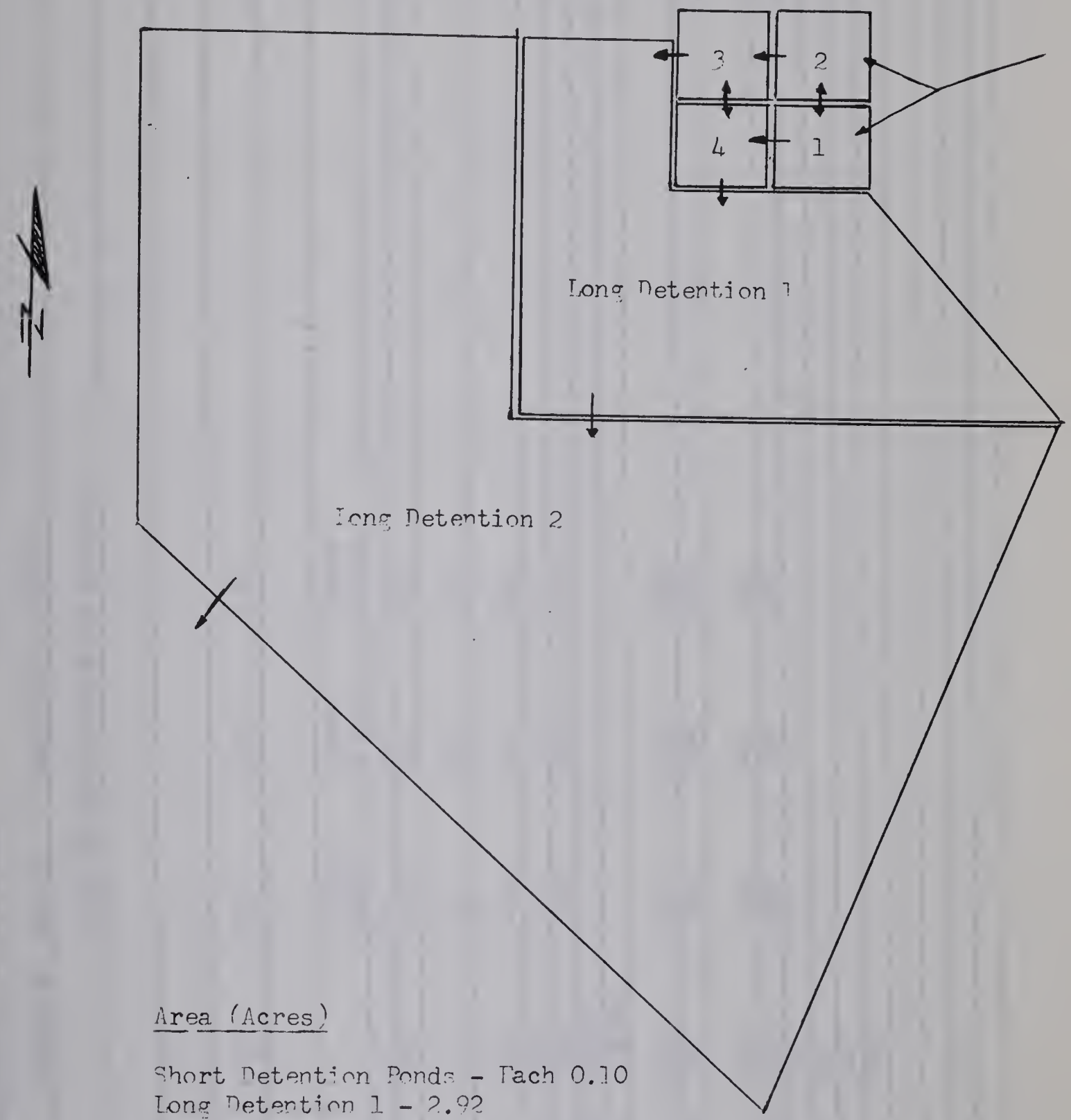
Suspended solids in the short detention cells were generally in the range of 50 to 150 ppm and decreased with detention time. In the long detention ponds the peak values were reached during the summer and the minimum values in the winter; the range being 10 to 150 ppm.

Odors in the vicinity of the long detention ponds were of very low concentration throughout the year. Generally, odors of moderate concentration were detectable from the short detention ponds at distances of about 300 feet. Once during the investigation period were odors noticeable at a distance of about 1,000 feet from the lagoon.

Ice thickness in the short detention ponds varied from less than one inch to one foot while maximum ice cover in the long detention pond was four feet.

PLAN OF INNISFAIL PONDS

Scale 1" = 200'



Area (Acres)

Short Detention Ponds - Each 0.10
Long Detention 1 - 2.92
Long Detention 2 - 14.0

Volume - (Million Gals.)

Short Detention Ponds - Each 0.339 @ 10 ft. Depth
Long Detention 1 - 3.98 @ 5 ft. Depth
Long Detention 2 - 26.7 @ 7 ft. Depth

Figure 9

Table 6A

SEWAGE POND STUDY

Location Innisfail Raw Sewage Sampling Point

Date		March7/62	May 12	Mayl3/64	May 14
Time			1p.m.-8p.m.	8a.m.-8p.m.	8a.m.-8p.m.
Wind, mphr.					
Light, fo.					
pH		7.9	7.7	7.65	7.85
D.O. ppm					
Temperature °C.			Varied 6to7.5	Varied 6 to 8	Varied 6 to 8
Alkalinity, ppm	pp	--	--	--	--
	MO	370	450	460	455
Odor, T.O.N.		80	50	100	40
B.O.D., ppm		348	169	287	242
Nitrogens, ppm	Total	50.5			
	Ammonia	35.0	37.0	36.3	42.5
	Nitrite	0.020			
	Nitrate	0.450			
Total Solids ppm	Total	806	980	1172	1228
	Volatile	305	326	494	491
Suspended Solids, ppm	Total	174	236	440	624
	Volatile	155	144	252	348
Chlorides ppm		64			
Sulfates ppm		76			
Phosphates ppm		60			
Detergents ppm		18.8			
Ice, feet					
Liquid, feet					
Overflow					

Table 6B

SEWAGE POND STUDY

Location Innisfail Short 1 — Sampling Point Outfall of Short Pond 1

Date		May 18/61	June 14/61	Nov,14/62	Dec.12	Jan.16/63	Feb. 27	Mar. 20	April 17
Time		4:30p.m.	12:20p.m.	12:15p.m.	11:55a.m.	11:15a.m.	12:50p.m.	12:00Noon	11:05a.m.
Wind, mphr.		--	--	CALM	CALM	CALM	CALM	5	15
Light, fo.		1000	1000	230	1000+	500	1000+	1000+	1000+
pH		7.55	7.40	7.4	7.4	7.7	7.55	7.6	7.4
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		12	19°	3	2	4	4	6	7
Alkalinity, ppm	pp			--	--	--	--	--	--
	MO	390	350	438	445	415	345	385	375
Odor, T.O.N.		1000	1000	1000	2000	2000	2000	1000	2000
B.O.D., ppm		194	181	228	271	182	194	202	206
Nitrogens, ppm	Total	36.4							
	Ammonia	32	75	46.8	44.8	38.5	34	35.7	39
	Nitrite	.002							
	Nitrate	.29							
Total Solids ppm	Total	753		766	767	716	652	741	705
	Volatile	268		269	297	233	255	298	264
Suspended Solids, ppm	Total	128		100	120	71	122	96	104
	Volatile	104		88	110	58	116	94	98
Chlorides ppm		65	75						
Sulfates ppm		75							
Phosphates ppm		34.2	NIL						
Detergents ppm		7.8							
Ice, feet		--		--	2"	0.3	--	--	--
Liquid, feet		--							
Overflow		~~X~~ NIL		YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Short 1 Sampling Point Outfall of Short Pond 1

Date		May 29	Sept. 11	Jan.8/64	April 8/64
Time		11:30a.m.	12:00	11:45a.m.	11:35a.m.
Wind, mphr.		10	10	CALM	CALM
Light, fo.		1000+	800	1000+	1000+
pH		7.35	7.30	7.50	7.45
D.O. ppm		NIL	NIL	NIL	NIL
Temperature °C.		16	16	5	8
Alkalinity, ppm	pp	--	--	--	--
	MO	400	415	440	400
Odor, T.O.N.		2000	1000	1000	5000
B.O.D., ppm		205	205	212	213
Nitrogens, ppm	Total				
	Ammonia	37.5	35	46	39.2
	Nitrite				
	Nitrate				
Total Solids ppm	Total	686	784	705	707
	Volatile	236	273	295	250
Suspended Solids, ppm	Total	146	160	82	90
	Volatile	144	176	80	89
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet			--	--	--
Liquid, feet					
Overflow		YES	YES	YES	YES

Table 6C

SEWAGE POND STUDY

Location Innisfail Short Pond 2 — Sampling Point Outfall of Pond

Date		May 18/61	June 14/61	Dec. 13/61	Jan. 10/62	Feb. 7	March 8	April 4	May 2
Time		4:45p.m.	12:30p.m.	10:30a.m.	9:55a.m.	9:30a.m.	9:15a.m.	10:05a.m.	12:15 p.m.
Wind, mphr.		--	--	CALM	CALM	10	CALM	CALM	20
Light, fo.		1000	1000	500	890	1000+	1000 +	1000+	1000+
pH		7.82	7.55	7.4	7.7	7.7	7.5	7.4	7.3
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		12°	19	3.0	3.0	2.5	3.0	8.0	10.0
Alkalinity, ppm	pp			--	--	--	--	--	--
	MO	380	370	360	395	430	325	300	355
Odor, T.O.N.		750	700	10,000	1000	2000	400	100	300
B.O.D., ppm		153	162	174	129	222	208	194	227
Nitrogens, ppm	Total	49		63.0	52.0	56.0	47.5	47.0	56.7
	Ammonia	33	74	47.0	49.0	51.0	42.0	36.0	32.0
	Nitrite	0.003		0.008	NIL	0.005	NIL	0.010	0.010
	Nitrate	0.16		0.250	0.445	0.325	0.275	0.1300	0.150
Total Solids ppm	Total	666		810	729	834	613	596	749
	Volatile	239		306	312	365	236	234	290
Suspended Solids, ppm	Total	100		64	94	205	98	77	77
	Volatile	88		60	83	177	90	63	77
Chlorides ppm		60	75	76	50	58	50	60	57
Sulfates ppm		63		92	111	101	95	58	58
Phosphates ppm		47	NIL	48	39	60	40	40	43
Detergents ppm		7.4		9.0	10.0	13.3	9.4	9.2	10.6
Oils & GREASE		1.4							
Ice, feet		--		0.5	0.4	0.3	0.3	--	--
Liquid, feet		--		5.0	4.0	1.0	1.0	2.0	2.0
Overflow		--		YES	YES	YES	YES		

SEWAGE POND STUDY

Location Innisfail Short Pond 2 Sampling Point Outfall of Pond

		July 5/62	July 25/62	Sept. 6/62
Time		11:15a.m.	4:10p.m.	10:30
Wind, mphr.		CALM	CALM	5
Light, fo.		Cloudy	Cloudy	1200
pH		7.15	7.4	7.15
D.O. ppm		NIL	NIL	NIL
Temperature °C.		20	20	16
Alkalinity, ppm	pp	--	--	--
	MO	375	360	400
Odor, T.O.N.			--	1000
B.O.D., ppm		166	197	171
Nitrogens, ppm	Total Ammonia	37.5	35	41.5
	Nitrite			
	Nitrate			
Total Solids ppm	Total	653	734	624
	Volatile	144	273	202
Suspended Solids, ppm	Total	66	91	81
	Volatile	53	88	73
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet				
Liquid, feet		No	2'0	8"
Overflow		YES	YES	YES

Table 6D

SEWAGE POND STUDY

Location Innisfail Short #3 — Sampling Point Outfall of Third Pond

Date		May 18/61	June 14/61	Dec. 13	Jan. 10/62	Feb. 7	March 8	April 4	May 2/62
Time		5:00-p.m.	12:20p.m.	8:40 AM	9:45a.m.	9:45 a.m.	9:30a.m.	9:55a.m.	12:10p.m.
Wind, mphr.		--	--	CALM	CALM	5	CALM	CALM	20
Light, fo.		1000	1000	500	890	1000+	1000+	1000+	1000+
pH		7.71	7.51	7.4	7.2	7.7	7.4	7.0	7.2
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		13	19°	0.5	0.5	0.2	1.0	7.0	10.0
Alkalinity, ppm	pp			--	—	--	--	--	--
	MO	405	400	410	390	465	350	330	340
Odor, T.O.N.		750	800	12000	800	1600	1000	400	400
B.O.D., ppm		146	159	150	160	195	122	198	203
Nitrogens, ppm	Total			64.2	52.5	55.0	47.0	52.7	50.4
	Ammonia	32.4	60	65.0	51.0	52.0	42.0	54.5	30.0
	Nitrite	0.003		0.006	NIL	0.002	NIL	0.020	0.001
	Nitrate	0.16		0.10	0.65	0.200	0.175	0.250	0.175
Total Solids ppm	Total	650		844	729	704	613	673	663
	Volatile	227		318	267	257	199	258	254
Suspended Solids, ppm	Total	72		49	74	81	77	94	75
	Volatile	64		45	60	72	67	80	65
Chlorides ppm		60	65	70	46	78	68	66	62
Sulfates ppm		52			100	110	90	67	70
Phosphates ppm		47	NIL	60	40	38	39	45	42
Detergents ppm		6.7		8.8	9.9	12.6	9.8	10.4	13.0
Oils G		0.7							
Ice, feet		--		0.7	0.1	0.3	0.5	--	--
Liquid, feet		--		7.0	4.0	3.0	3.0	2.0	2.0
Overflow		--		YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Short #3 Sampling Point Outfall of Third Pond

Date		July 5/62	July 25/62	Sept. 6	Nov. 14	Dec. 12
Time		11:10a.m.	4:05a.m.	10:20a.m.	12:20p.m.	11:35a.m.
Wind, mphr.		CALM	CALM	5	CALM	CALM
Light, fo.		Sunny	Cloudy	1200	230	1000+
pH		7.35	7.4	7.2	7.3	7.35
D.O. ppm		NIL	NIL	NIL	NIL	NIL
Temperature °C.		19	20	15	2	2
Alkalinity, ppm	pp		--	--	--	--
	MO	365	420	375	460	465
Odor, T.O.N.			--	500	200	400
B.O.D., ppm		156	135	150	160	172
Nitrogens, ppm	Total Ammonia	42	38.5	37.5	39.5	42
	Nitrite					
	Nitrate					
Total Solids ppm	Total	651	743	672	711	744
	Volatile	221	246	250	228	270
Suspended Solids, ppm	Total	77	46	48	56	71
	Volatile	64	45	47	50	66
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Ice, feet		--	--	---	--	4"
Liquid, feet						
Overflow		YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Short #3 Sampling Point Outfall or 3rd Pond

Date		Jan. 16/63	Feb. 27	Mar. 20	April 17	May 29	Sept. 11	Jan. 8/64
Time		11:25a.m.	12:45p.m.	11:55a.m.	10:50a.m.	11:20 AM	12:05 PM	
Wind, mphr.		CALM	CALM	5	6	5	10	
Light, fo.		500	1000+	1000+	1000+	1000+	800	
pH		7.4	7.4	7.5	7.55	7.5	7.4	
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	
Temperature °C.		2	3	4	6	16	17	
Alkalinity, ppm	pp	--	--	--	--	--	--	
	MO	430	350	380	370	430	440	
Odor, T.O.N.		1000	1000	1000	1000	900	1000	
B.O.D., ppm		208	187	182	168	165	145	
Nitrogens, ppm	Total Ammonia	35.5	36	37.5	40.5	37.5	32.5	
	Nitrite							
	Nitrate							
Total Solids ppm	Total	765	587	682	654	658	727	
	Volatile	296	227	248	255	235	294	
Suspended Solids, ppm	Total	124	56	66	92	76	130	
	Volatile	96	54	62	88	72	130	
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet		0.5	0.2	--	--	--	--	
Liquid, feet								
Overflow		YES	YES	YES	YES	YES	YES	

BY PASSED

Table 6E

SEWAGE POND STUDY

Location Innisfail Short 4 — Sampling Point Outfall of 4

Date		Dec. 13/61	Nov. 14/62	Dec. 12	Jan. 16/63	Feb. 27	Mar. 20	April 17	May 29/63
Time		11:00a.m.	12:25p.m.	11:45 AM	11:25 AM	12:40 PM	11:50 AM	11:00a.m.	11:15a.m.
Wind, mphr.		CALM	CALM	CALM	CALM	CALM	5	15	10
Light, fo.		820	230	1000+	500	1000+	1000+	1000+	1000+
pH		7.6	7.4	7.35	7.45	7.5	7.5	7.5	7.4
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		1.0	2	2	2	3	5	6	15
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	460	450	455	435	355	390	355	390
Odor, T.O.N.		10,000	400	1000	2000	1000	1000	1000	1000
B.O.D., ppm		77	172	208	174	175	191	191	181
Nitrogens, ppm	Total	78.2							
	Ammonia	68.0	42.5	43	35.8	35	44.5	41	35
	Nitrite	0.008							
	Nitrate	0.10							
Total Solids ppm	Total	870	730	742	720	629	703	644	684
	Volatile	328	241	270	242	221	225	244	256
Suspended Solids, ppm	Total	49	74	77	92	51	62	120	82
	Volatile	45	66	73	78	50	62	110	78
Chlorides ppm		80							
Sulfates ppm		98							
Phosphates ppm		64							
Detergents ppm		9.0							
Ice, feet		1.0	--	4"	1'	0.2	--	--	-
Liquid, feet		6.0							
Overflow			YES	YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Short 4 Sampling Point Outfall of 4

Date		Sept. 11/63	Jan.8/64	April 8/64
Time		11:15 AM	11:40a.m.	11:30a.m.
Wind, mphr.		10	CALM	CALM
Light, fo.		800	1000+	1000+
pH		7.35	7.3	7.40
D.O. ppm		NIL	NIL	NIL
Temperature °C.		17	3	6
Alkalinity, ppm	pp	--	--	--
	MO	420	455	405
Odor, T.O.N.		700	800	400
B.O.D., ppm		167	167	157
Nitrogens, ppm	Total Ammonia	34.3	46	40.0
	Nitrite			
	Nitrate			
Total Solids ppm	Total	945	695	693
	Volatile	500	263	253
Suspended Solids, ppm	Total	172	54	80
	Volatile	170	50	60
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		--	0.3	--
Liquid, feet				
Overflow		YES	YES	YES

Table 6F

SEWAGE POND STUDY

Location Innisfail Long Det. 1 Sampling Point Outfall of Long Det. 1

Date		May 18/61	June 14	Dec. 13/61	Jan. 10/62	Feb. 7	March 8	April 4	May 2/62
Time		5:10p.m.	12:50p.m.	9:25a.m.	10:45a.m.	10:00a.m.	9:00a.m.	10:15a.m.	12:00p.m.
Wind, mphr.		--	--	5	CALM	5	CALM	CALM	15
Light, fo.		1000	1000	300	1000+	1000+	1000+	1000+	1000+
pH		7.6	7.8	7.7	7.8	7.4	7.4	7.1	7.5
D.O. ppm		NIL	10.5	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		13	24	0.5	0.5	0.2	0.5	3.0	10.0
Alkalinity, ppm	pp			--	--	--	--	--	--
	MO	425	460	470	550	650	615	235	400
Odor, T.O.N.		400	200	400	200	2500	4000	500	500
B.O.D., ppm		147	157	--	100	147	159	124	114
Nitrogens, ppm	Total	40.6		40.6	52.5	56.0	71.0	35.9	45.4
	Ammonia	35.9	37	35.5	61.0	52.0	58.0	34.0	26.5
	Nitrite	0.002		0.004	NIL	0.001	NIL	0.050	0.003
	Nitrate	0.14		0.050	0.425	0.188	0.154	0.275	0.100
Total Solids ppm	Total	617		774	834	821	942	425	551
	Volatile	196		220	285	286	295	163	187
Suspended Solids, ppm	Total	42		24	34	49	59	50	35
	Volatile	42		24	34	49	48	42	35
Chlorides ppm		55	65	90	76	82	106	42	52
Sulfates ppm		30			111	78	100	45	85
Phosphates ppm		53	NIL	100	53	40	56	37	78
Detergents ppm		8.1		78	11.2	12.2	11.6	10.7	9.5
Oils GREASE		1.0							
Ice, feet		--		1.5	3.0	3.0	4.0	--	--
Liquid, feet		--		5.0	3.0	2.0	2.0	2.0	2.0
Overflow		--		YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location: Innisfail Long Det. 1 — Sampling Point: Outfall of Long Det. 1

Date		July 5/62	July 25/62	Sept. 6	Nov. 14	Dec. 12/62	Jan. 16/63	Feb. 27	Mar. 20
Time		11:05a.m.	4:00p.m.	10:00a.m.	12:10p.m.	11:25a.m.	11:30a.m.	12:30p.m.	11:45a.m.
Wind, mphr.		CALM	CALM	5	CALM	Calm	CALM	CALM	5
Light, fo.		Sunny	Cloudy	1200	220	1000+	500	1000+	1000+
pH		8.1	8.3	8.0	7.85	7.4	7.35	7.5	7.45
D.O. ppm		1.70	7.0	6.0	2.2	NIL	NIL	NIL	NIL
Temperature °C.		20	20	16	2	1	0.5	2	3
Alkalinity, ppm	pp	—	--	--	--	--	--	--	—
	MO	315	380	365	415	505	465	400	400
Odor, T.O.N.			--	4	16	100	500	400	300
B.O.D., ppm		63	19	39	46	113	175	189	157
Nitrogens, ppm	Total								
	Ammonia	29.5	34.5	16	25	43	37	39.5	40.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	587	619	678	710	761	752	666	655
	Volatile	218	188	254	242	236	266	239	168
Suspended Solids, ppm	Total	79	13	82	92	66	52	38	30
	Volatile	60	12	82	88	63	40	36	28
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet					0.1	1½'	2.0	2.0	2.0
Liquid, feet		2.0				5'	4.5		
Overflow		YES	YES	YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Long Det. 1, Sampling Point Outfall of Long Det. 1

Date		April 17	May 29	Sept. 11	Jan. 8/64	April 8/64
Time		10:40a.m.	11:05	11:10a.m.	11:30a.m.	11:15a.m.
Wind, mphr.		15	10	10	CALM	CALM
Light, fo.		1000+	1000+	800	1000+	1000+
pH		7.55	8.0	7.85	7.4	7.3
D.O. ppm		NIL	NIL	NIL	NIL	NIL
Temperature °C.		5	15	17	1	3
Alkalinity, ppm	pp	--	--	--	--	--
	MO	365	440	395	520	390
Odor, T.O.N.		500	100	50	200	100
B.O.D., ppm		159	53	30	152	125
Nitrogens, ppm	Total					
	Ammonia	38	30.5	16.0	48.0	37.5
	Nitrite					
	Nitrate					
Total Solids ppm	Total	534	642	755	680	603
	Volatile	188	196	384	271	193
Suspended Solids, ppm	Total	46	80	156	28	36
	Volatile	38	80	144	27	28
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Ice, feet		--	--	--	1.5	0.5
Liquid, feet						
Overflow		YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Innisfail Long Detention 2 Sampling Point Outfall of Long Detention 2

Date		May 18/61	June 14	Dec. 13	Jan. 10/62	Feb. 7	Mar. 8	Mar. 19	May 2 /62
Time		5:20 pm	1:00 pm	9:15 am	11:15 am	10:30 am	8:45 am	3:15 pm	10:30 am
Wind, mphr.		-	-	5	Calm	5	Calm	Calm	10
Light, fo.		1000	1000	240	1000+	1000+	1000+	Cloudy	800
pH		9.5	9.4	8.0	9.6	9.0	8.7		7.8
D.O. ppm		30	1.25	11.1	12.6	6.4	4.8	Nil	Nil
Temperature °C.		13	25	2.0	0.5	0.2	0.2		11.0
Alkalinity, ppm	pp	75	75	-	80	52	28		-
	MO	245	165	300	650	650	590		300
Odor, T.O.N.		100	40	100	4	4	300		20
B.O.D., ppm		42.6	27	-	4	39	35	61	34
Nitrogens, ppm	Total	16.5		39.8	9.7	24.0	20.6		22.2
	Ammonia	7.2	6.0	16.5	4.0	12.0	13.0		12.5
	Nitrite	0.005		0.036	Nil	0.060	Nil		0.001
	Nitrate	0.25		0.075	0.233	0.325	0.360		0.025
Total Solids ppm	Total	494		578	722	777	876		476
	Volatile	209		167	252	247	251		154
Suspended Solids, ppm	Total	174		27	10	24	22		41
	Volatile	114		27	10	24	22		41
Chlorides ppm		45	55	86	76	112	112		60
Sulfates ppm		26			68	70	68		50
Phosphates ppm		10.5	0.5	7.5	15	20	22		18
Detergents ppm		7.5		6.0	8.7	10.1	9.6		7.1
Oils and G		0.5							
Ice, feet		-		2.0	3.0	3.0	4.0	4.0	-
Liquid, feet		-		2.0	1.0	2.0	2.0	2.0	3.0
Overflow		-						No	Yes
		Sour odor							

Drained for Approximately 1 hour 5 days/week, from December 13 to February 7. Practice halted March 19/62.

SEWAGE POND STUDY

Location: Innisfail Long Detention 2 — Sampling Point: Outfall of Long Detention 2

		July 5/62	July 25	Sept. 6	Nov. 14	Dec. 12	Jan. 16	Feb. 27	Mar. 20
Time		11:00 am	3:50 pm	9:30 am	11:55 am	11:10 am	Noon 12:00	12:15 pm	11:30 AM
Wind, mphr.		Calm	Calm	5	Calm	Calm	Calm	Calm	5
Light, fo.		Sunny	Cloudy	1200	230	1000+	500	1000+	1000+
pH		8.5	9.5	10.35	8.5	8.7	7.85	8.0	7.5
D.O. ppm		7.60	33.0	18	9.0	8.0	Nil	Nil	Nil
Temperature °C.		20	20	15	3	1	1	2	1
Alkalinity, ppm	pp	15	85		85	-	-	-	-
	MO	205	255	T=170	265	T=400	660	540	415
Odor, T.O.N.			-	2	8	4	200	100	400
B.O.D., ppm		13	9	18	23	28	88	119	152
Nitrogens, ppm	Total Ammonia	17	4.5	3.8	8.5	14.75	32	33	44.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	491	533	572	693	828	1036	897	666
	Volatile	147	197	399	265	241	292	276	193
Suspended Solids, ppm	Total	47	69	124	116	104	33	17	22
	Volatile	30	51	104	110	94	27	15	21
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		-	-	-	½"	1½' 2' Liq.	2.0	3'	3'
Liquid, feet							2 0	2.0	2.5
Overflow		Yes Drain	Yes Drain	No W. Depth 1½'	No	No	No	No	No

SEWAGE POND STUDY

Location Innisfail Long Detention 2 **Sampling Point** Outfall of Long Detention 2

Date		April 17/63	May 29	Sept. 11	Jan. 8/64	April 8/64			
Time		10:30 a.m.	10:00 a.m.	10:00 a.m.	11:10 a.m.	11:00 a.m.			
Wind, mphr.		15	10	10	Calm	Calm			
Light, fo.		1000+	1000+	800	1000+	1000+			
pH		7.65	8.05	8.8	7.35	7.5			
D.O. ppm		Nil	1	1	Nil	Nil			
Temperature °C.		3	15	17	1	2			
Alkalinity, ppm	pp	-	-	15	-	-			
	MO	275	395	285	720	265			
Odor, T.O.N.		500	30 grassy	10 grassy	50	50			
B.O.D., ppm		87	46	11	106	69			
Nitrogens, ppm	Total Ammonia	26	24	3	47	22.5			
	Nitrite								
	Nitrate								
Total Solids ppm	Total	453	596	573	854	405			
	Volatile	172	162	178	300	128			
Suspended Solids, ppm	Total	26	64	142	39	60			
	Volatile	22	60	138	39	20			
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		In spots	-	-	1.5	0.5 - 1.0			
Liquid, feet		6.5	7.75	4.5	7.5				
Overflow		No	No	No	No	No			

ALKALINITY

LONG DETENTION PONDS

PPM

650
600
550
500
450
400
350
300

—— Pond 1
--- Pond 2

Alkalinity
Short Detention
Ponds

PPM

250
200
450
400
350
300

Pond 1
Pond 2
Pond 3
Pond 4

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

Innisfail

Ammonia - Nitrogen Long Detention Ponds

PPM

70
60
50
40
30
20
10
0

Pond 1
Pond 2

Ammonia - Nitrogen Short Detention Ponds

PPM

70
60
50
40
30

Pond 1
Pond 2
Pond 3
Pond 4

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

Innisfail

A-80

pH - Long Detention Ponds

Pond 1 ——
Pond 2 - - -

10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0

pH - Short Detention Ponds

Pond 1 ——
Pond 2 - - -
Pond 3 — · —
Pond 4 ——

8.0
7.5
7.0

Dec. Jan. Feb. Mar Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

Innisfail

Dissolved Oxygen
Long Detention Ponds

PPM

30
20
10

— Pond F
--- Pond G

Temperature
Long Detention
Ponds

°C

20
15
10
5
0

— Pond F
--- Pond G

Temperature
Short Detention
Ponds

°C

20
15
10
5
0

1961 Dec. Jan. Feb. 1962 Mar Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. 1963 Mar. Apr. May June July Aug. Sept. Oct. Nov. 1964 Dec. Jan. Feb. Mar. Apr.

Innisfail

Odor - Long Detention Ponds

T.O.N.

2000
1000

2500
4000
1000
5000

Pond 1
Pond 2

Odor - Short Detention Ponds

T.O.N.

2000
1000

Pond 1
Pond 2
Pond 3
Pond 4

B.O.D. Long Detention Ponds

PPM

200
150
100
50
0

Pond 1
Pond 2

B.O.D. Short Detention Ponds

PPM

250
200
150

Pond 1
Pond 2
Pond 3
Pond 4

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May

1961 1962 1963 1964

Innisfail

Figure 10

Innisfail

Suspended Solids
Long Detention Ponds

Pond 1
Pond 2

PPM
200
150
100
50
0
250
200
150
100
50

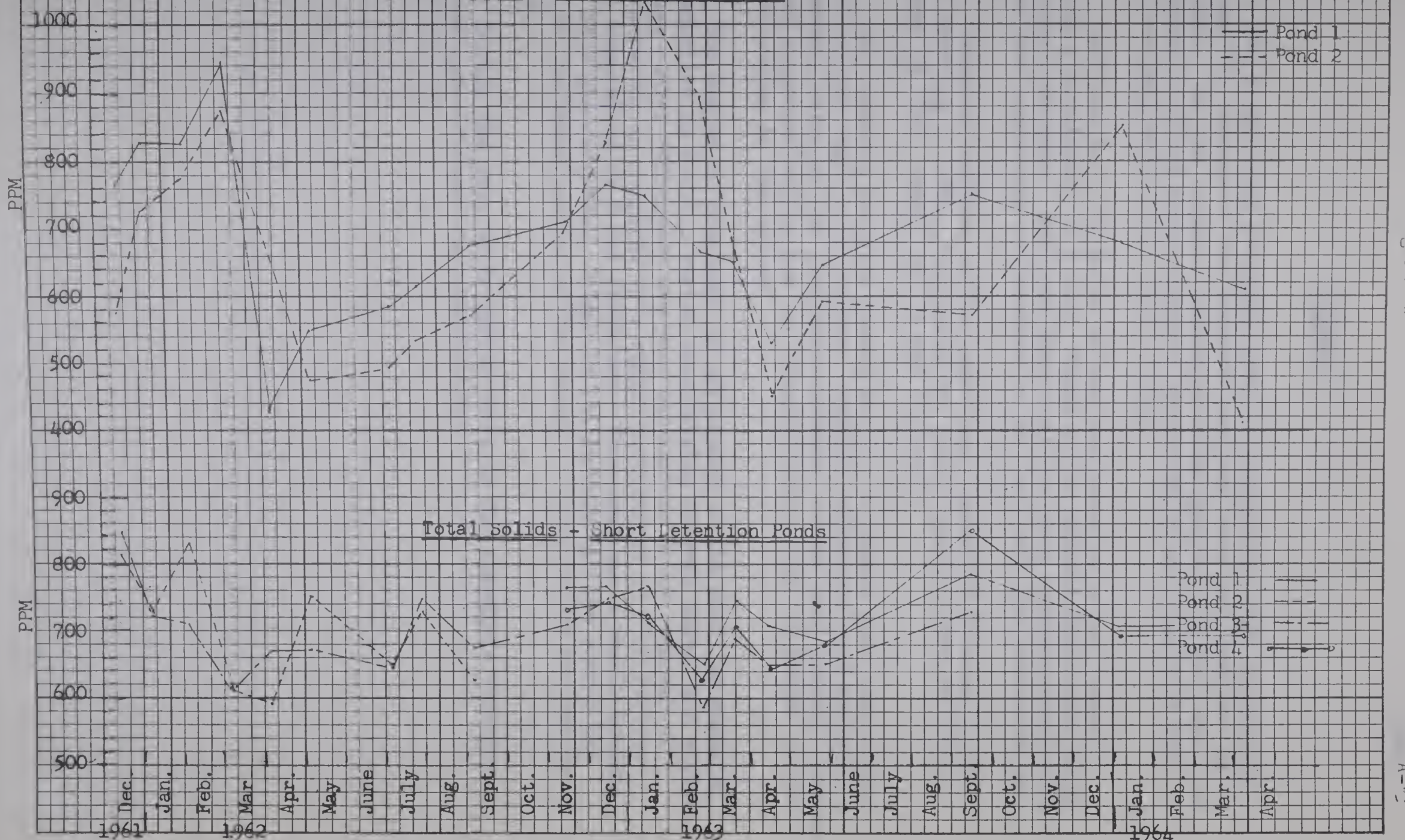
Suspended Solids
Short Detention Ponds

Pond 1
Pond 2
Pond 3
Pond 4

PPM

1961 Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1962 Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1963 Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1964 Jan. Feb. Mar. Apr.

Total Solids - Long Detention Ponds



Total Solids - Short Detention Ponds

Figure 10

A-03

Innisfail

LACOMBE

The single long detention pond at Lacombe has been previously studied and the results of the chemical analyses were published in the fall of 1961. In the recently completed investigation this pond was used as a reference for the newly designed lagoons which were based on recommendations published in the fall of 1961.

The pond is 16.64 acres in area and receives a raw domestic sewage from a population of 3,140. There are no unusual industries which will overload the pond. The pond was operated with a continuous overflow throughout the summer and was drained in the late fall for winter storage.

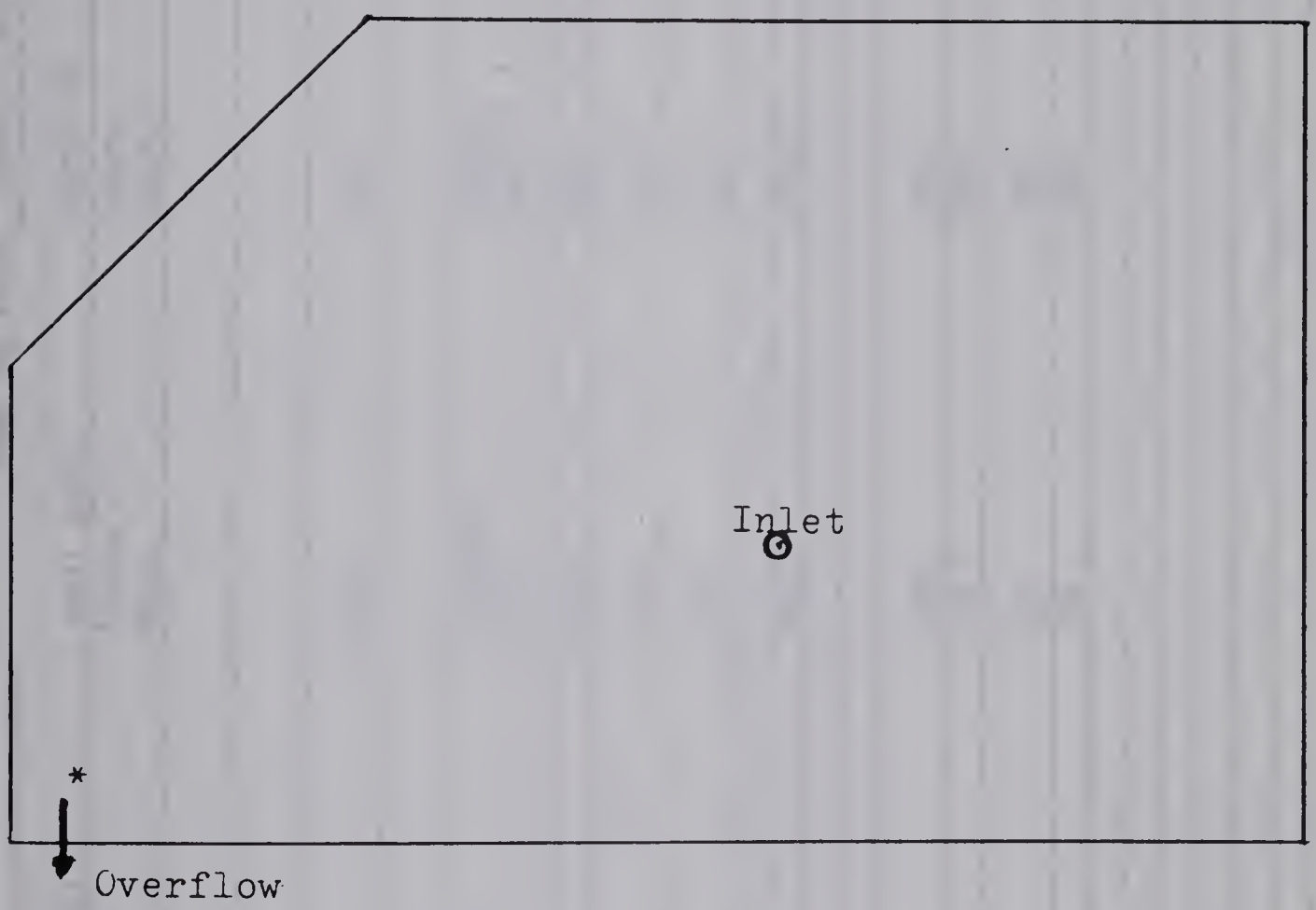
Chemical analyses of the liquid were conducted between May 31, 1961 and February 4, 1964. Composite raw sewage samples were collected on November 19 1963, April 28, 29 and 30, 1964.

The chemical analyses showed the B.O.D. values were much higher during the winter than in the summer. Similar conditions were observed in the ammonia-nitrogen and alkalinity contents of the pond liquid. However, the pH and suspended solids had the reverse effect, that is maxima in the summer and minima in the winter.

The degree of treatment or efficiency of the pond, as measured by the reduction in B.O.D., varied considerably between summer and winter. The average winter efficiency was 30.1 per cent or B.O.D. removal of 7.74 lb./acre/day as compared to a summer performance of 92.0 per cent or B.O.D. removal of 23.6 lbs./acre/day. This pond has a yearly loading of about 25.7 lbs./acre/day. Algae in the pond during the summer has assisted in the stabilization of the sewage as indicated by the degree of treatment.

During the open water period odors in the immediate vicinity of the pond were of very low concentration.

Plan of Lacombe Sewage Pond



Scale - 1" = 200'
* - Sampling Point

Area - 16.64 Acres
Capacity - 22.6 Million Gals. @ 5 ft. Depth

Figure 11

Table 7A

SEWAGE POND STUDY

Location Lacombe Raw — Sampling Point Manhole Before Lift Station

Date		Nov. 19/63	April 28/64	April 29	April 30
Time		8a.m. - 12 Mid.	11a.m. - 8p.m.	8a.m. - 8p.m.	8a.m. - 8p.m.
Wind, mphr.					
Light, fo.					
pH		8.2	8.0	8.0	8.5
D.O. ppm					
Temperature °C.		Constant 11	Constant 10	Varied 9-10	Varied 9-10
Alkalinity, ppm	pp	—	—	—	18
	MO	720	666	700	725
Odor, T.O.N.		400	100	200	300
B.O.D., ppm		332	355	307	254
Nitrogens, ppm	Total Ammonia	51.0	44.0	45.0	650
	Nitrite				
	Nitrate				
Total Solids ppm	Total	1250	1074	1310	1099
	Volatile	491	304	482	339
Suspended Solids, ppm	Total	282	220	288	215
	Volatile	280	164	160	120
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet					
Liquid, feet					
Overflow					

Table 7B

SEWAGE POND STUDY

Location Lacombe — Sampling Point Outfall of Pond

Date		May 31/61	Dec. 6/61	Jan. 3/62	Jan. 31/62	March 1/62	March 28/62	April 25/62	July 19/62
Time		2^00 p.m.	11^35 a.m.	12^30 p.m.	11^30 a.m.	4^40 p.m.	10^40 p.m.	11^10 a.m.	1^30 p.m.
Wind, mphr.		10	Calm	Calm	Calm	5	5	Calm	Calm
Light, fo.		1000	1000	400	1000+	320	1000+	1000+	Cloudy
pH		9.4	7.4	8.8	8.5	7.8	7.7	7.1	8.3
D.O. ppm		16.9	NIL	NIL	NII	NIL	NIL	NIL	7.4
Temperature °C.		24.0	1.0	1.0	0.2	0.1	0.5	9.0	18
Alkalinity, ppm	pp	490	—	85	20	--	--	--	--
	MO	600	1735	1600	2250	1650	620	365	535
Odor, T.O.N.		3	1000	30	80	3000	3000	800	—
B.O.D., ppm		51	160	253	348	177	220	123	31
Nitrogens, ppm	Total	14.0	118.0	75.5	166.0	124.0	63.0	33.4	
	Ammonia	6.8	90.0	69.0	109.0	80.0	51.0	18.0	12.5
	Nitrite	0.016	0.007	0.003	0.047	0.012	0.020	0.040	
	Nitrate	0.4	0.04	0.212	1.180	0.350	0.150	0.000	
Total Solids ppm	Total	1071	2260	2114	3148	2240	916	529	935
	Volatile	252	325	467	646	483	246	109	227
Suspended Solids, ppm	Total	90	52	52	80	139	57	32	88
	Volatile	64	44	41	71	100	48	32	80
Chlorides ppm		145	169	142	276	152	68	44	
Sulfates ppm		432	75	150	193	171	188	58	
Phosphates ppm		3.8	117	51	158	124	35	28	
Detergents ppm		4.6	6.4	19.6	21.2	18.7	8.9	5.2	
Ice, feet		—	1.0	1.5	3.5	5.0	—	—	—
Liquid, feet		—	3.0	1.0	1.0	0.5	—	2.0	22.0
Overflow		—	No	No	NO	No	Yes	Yes	No

SEWAGE POND STUDY

Location Lacombe — Sampling Point Outfall of Pond

Date		Aug. 23/62	Nov. 7	Dec. 5	Jan. 8/63	Feb. 6	Mar. 13	April 10/63	Nov. 19
Time		1^{00} p.m.	4^{45} p.m.	1^{45} p.m.	2^{20} p.m.	11^{30} a.m.	2^{30} p.m.	1^{00} p.m.	4^{00} p.m.
Wind, mphr.		5	15	Calm	Calm	5	Calm	10	Calm
Light, fo.		800	200	600	1000+	1000+	1000+	1000+	800
pH		9.30	8.1	7.85	7.35	7.9	7.75	7.6	8.2
D.O. ppm		17.5	7.3	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		17	4	3	1.0	1.0	2	4	1
Alkalinity, ppm	pp	85	—	—	—	—	—	—	—
	MO	490	615	875	1475	650	620	555	910
Odor, T.O.N.		2	10	3000	3000	2000	500	500	500
B.O.D., ppm		20	39	—	251	232	170	166	80
Nitrogens, ppm	Total Ammonia	6.5	14	47	71	44.5	38	39.5	30.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1132	925	1176	1772	969	893	775	2765
	Volatile	322	208	243	272	184	185	203	405
Suspended Solids, ppm	Total	222	68	96	74	71	74	48	168
	Volatile	212	66	86	74	61	72	32	138
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		—	—	1½	1½	3'-3.5		Yes	0.2
Liquid, feet						1.0			1.0
Overflow		No	No	No	No	NO	Yes	Yes	No

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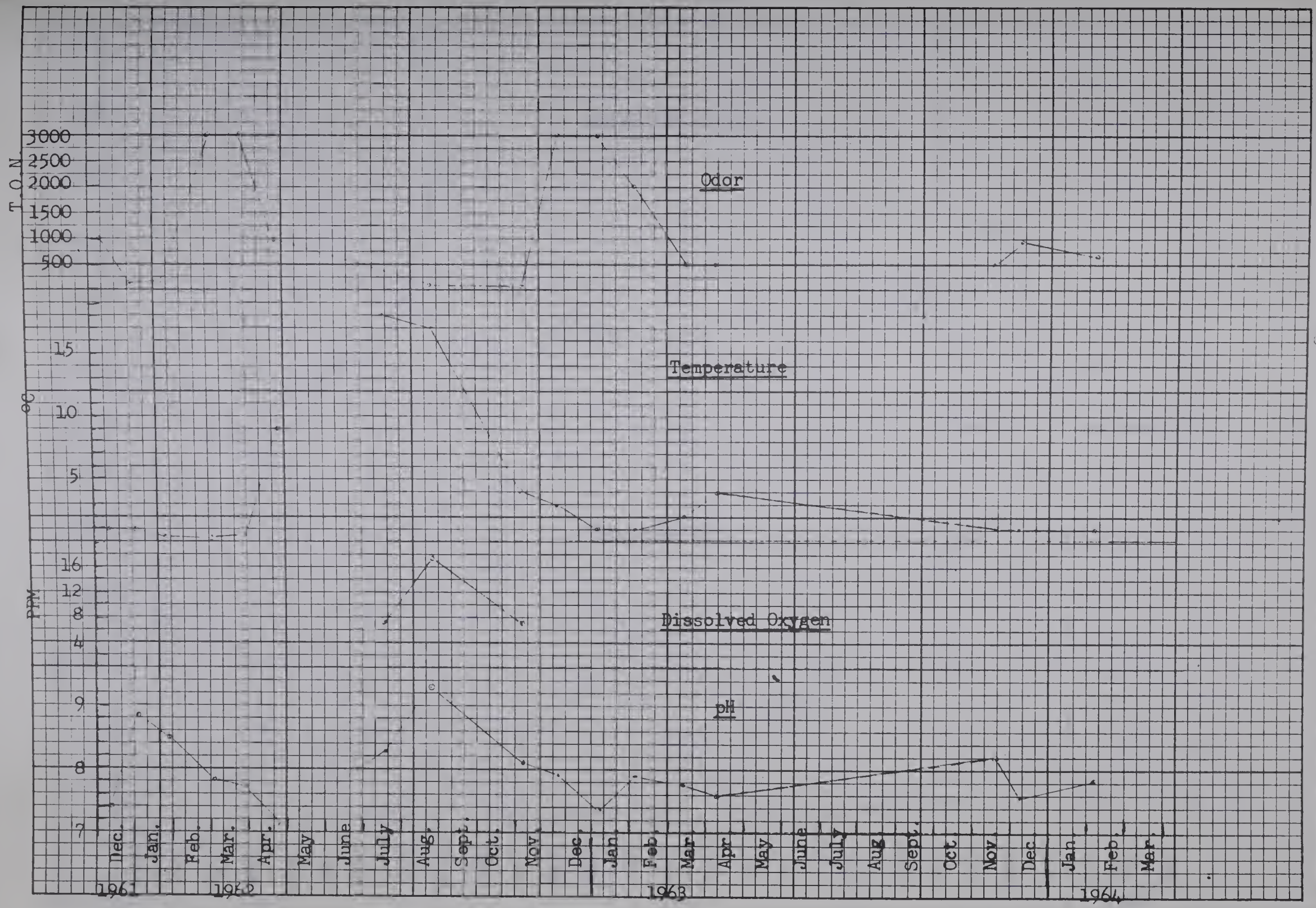
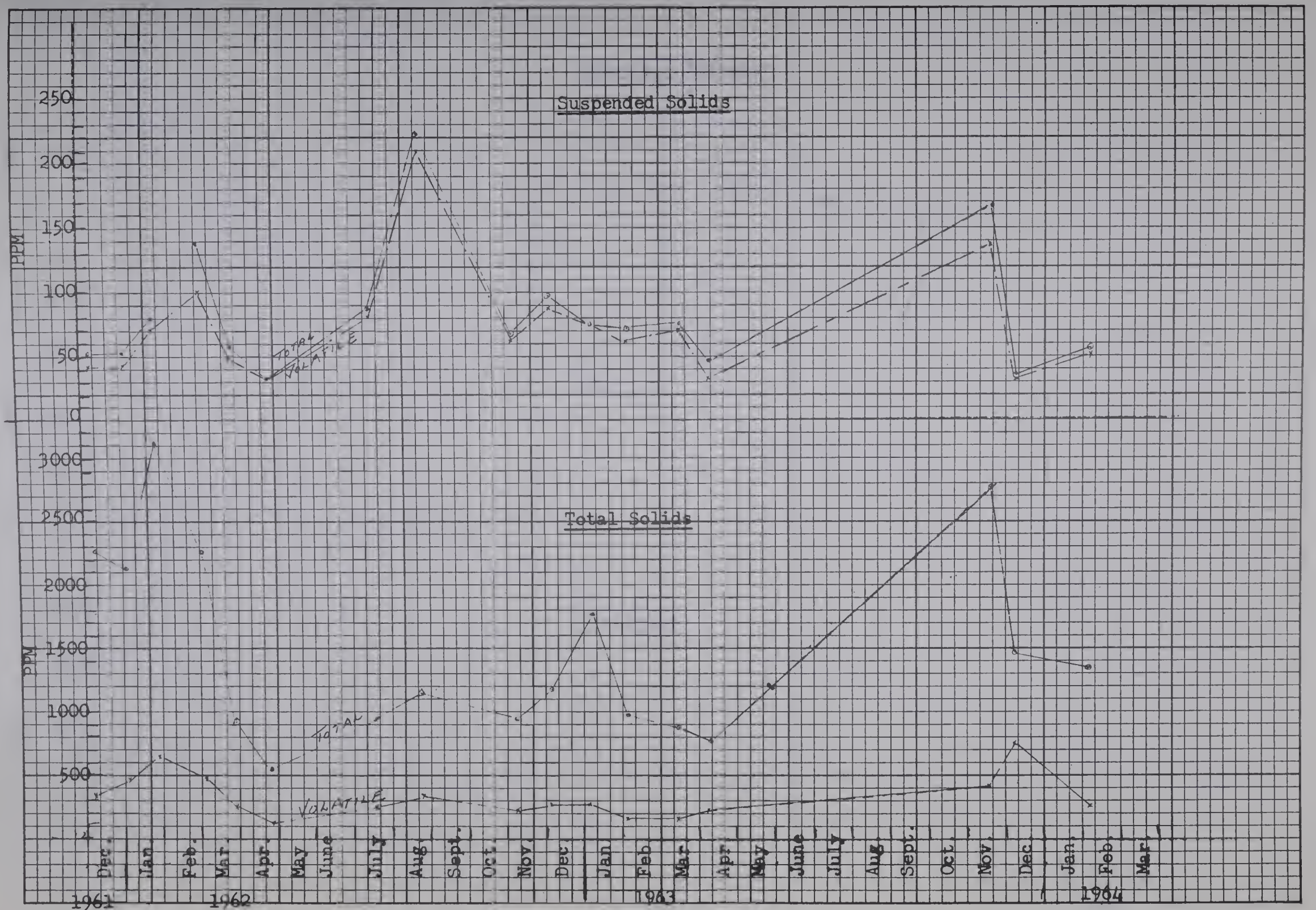
SEWAGE POND STUDY

Location Lacombe — Sampling Point Outfall of Pond

Date		Dec. 4	Feb. 4/64
Time		1[50]	1[50] p.m.
Wind, mphr.		Calm	Calm
Light, fo.		1000 +	1000 +
pH		7.55	7.8
D.O. ppm		NIL	NIL
Temperature °C.		1	1
Alkalinity, ppm	pp	--	--
	MO	990	1115
Odor, T.O.N.		800	700
B.O.D., ppm		141	226
Nitrogens, ppm	Total Ammonia	47.5	70
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1423	1318
	Volatile	743	269
Suspended Solids, ppm	Total	34	54
	Volatile	32	52
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		0.5	2.5
Liquid, feet		1.5	2.0
Overflow		No	No



Lacombe Sewage Pond Trends



Lacombe Sewage Pond Trends

Figure 12

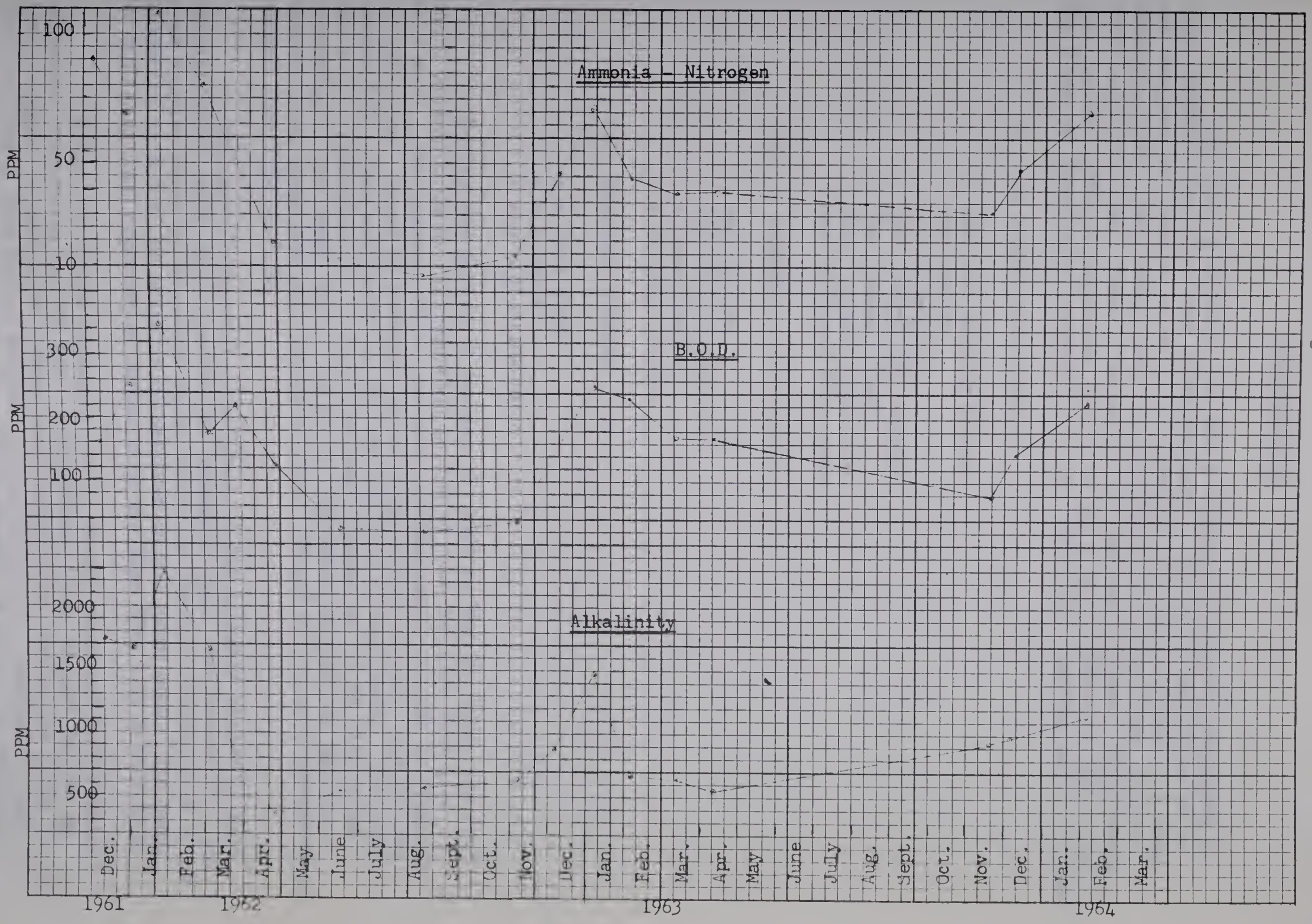


Figure 12

Lacombe Sewage Pond Trends

MEDICINE HAT

The City of Medicine Hat has a sewage pond system consisting of four anaerobic and one long detention ponds. The short detention ponds are designed to operate in series or parallel with the overflow to a long detention pond. Raw sewage from all sections of the city flows to three lift stations; namely Purmal, Balmoral, and Crescent Heights. This sewage pond system serves a population of 25,000 and a large number of industries. The types of industries discharging to the three lift stations are as follows:

(a) to Purmal lift station:

- two meat packing plants
- one foundry
- two flour mills
- one linseed oil company
- one beverage plant
- three pottery industries
- one brick and tile plant

(b) to Balmoral lift station:

- two dairies
- two fruit wholesalers
- a steam laundry
- a railway company

(c) Crescent Heights

- a tire plant
- a hospital
- one soft drink plant

During the period of January 17, 1962 to May 23, 1962, the four short detention ponds were operated in series with the flow from 1 to 2 to 3 to 4. The largest of the two meat packing plants was not in operation at this time. Based on averages of all samples and one flow rate, the raw sewage B.O.D. was calculated as 203 ppm for this winter period. The overall B.O.D. reduction for the short detention ponds was 77.8% with 60.0% occurring in the first pond. The B.O.D. reduction provided by each successive pond decreased with detention time. The pH of the pond supernatants ranged from 7.32 to 7.50.

The major industrial contributor to the sewerage system, a meat packing plant, went into operation in September 1962. On October 15, 1962 grab samples from the anaerobic ponds showed an overall efficiency of 72.4% reduction in B.O.D. of which 61.0% occurred in the first pond. The ponds at this time were operated in series with the flow from 1 to 2 to 3 to 4.

After the spring breakup in 1963, strong odors and large "boils" developed from ponds one and two. Furthermore, these "boils" buoyed up large volumes of undigested sludge, and subsequently turned the ponds "sour". The flow during this period was from 2 to 1 to 4 to 3. Samples on June 7 1963 indicated a negative reduction (or increase) in B.O.D. in pond number two while pond one had a B.O.D. removal of 55.1% as an individual unit.

In July, the pH of ponds one and two dropped below 7.0 giving acid conditions. The maximum B.O.D. loading was 8.9 lbs/1000 ft.3/day or 3,910 lbs./acre/day which is below the suggested maximum of 4,000 lb./acre/day.

Acti-zyme was added to the raw sewage in an attempt to alleviate the "sour" conditions and the odor problem which persisted throughout the summer. At the same time the system was operated in parallel - series, thus reducing the B.O.D. load on each cell. The chemical acti-zyme was used for nearly two months with no spectacular results. Although the acid conditions in the ponds were relieved, as indicated by pH readings, the odors still existed in the vicinity of the ponds. While using the acti-zyme the B.O.D. reduction averaged 86.0% in the ponds.

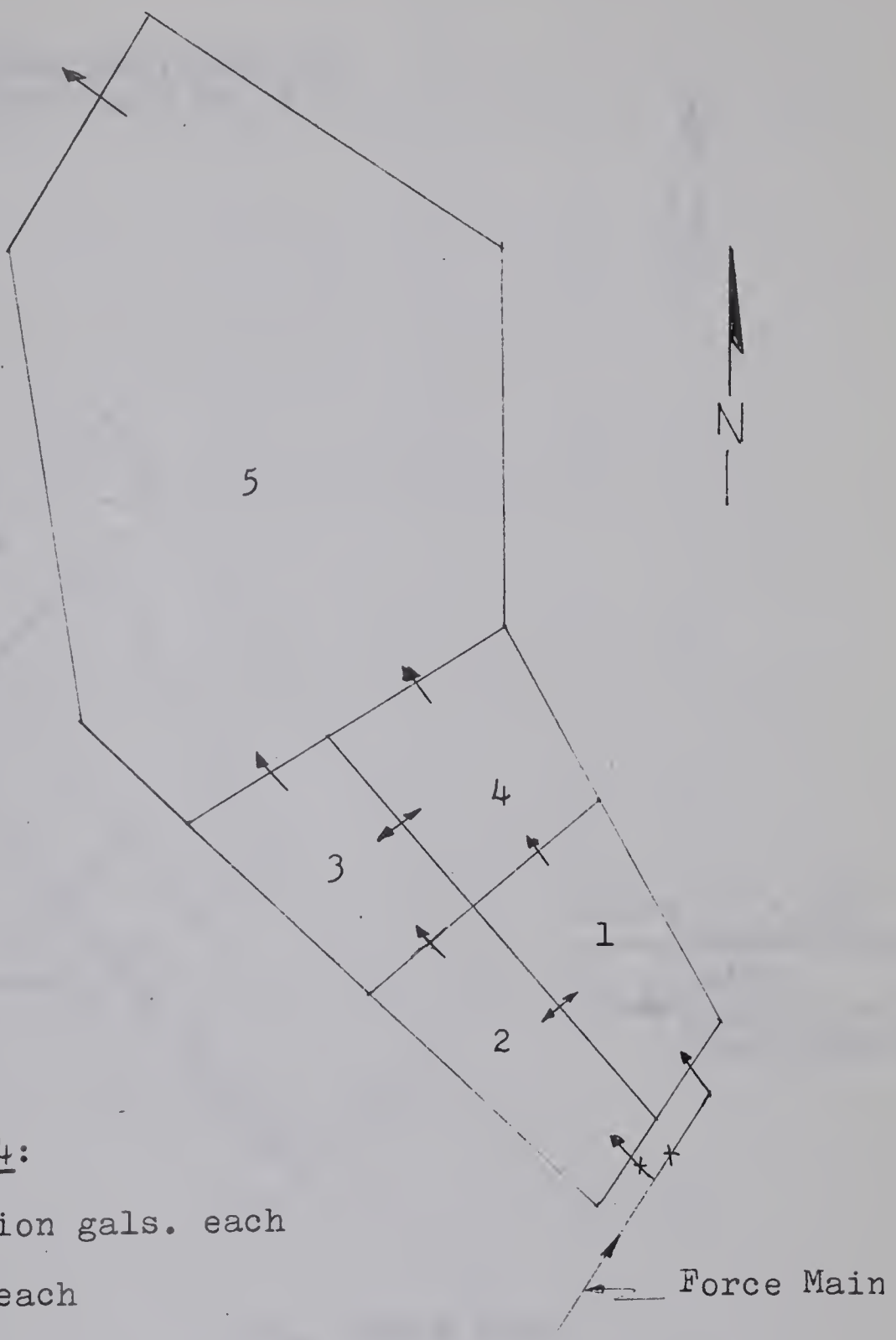
Lime was boardcast over the ponds immediately after acti-zyme was discontinued. The ponds were now operated in series with the flow from 1 to 2 to 3 to 4. The addition of lime certainly raised the pH of the supernatant and the sludge to proper anaerobic conditions, but the odors still seem to have existed.

In November 1963 a multiple inlet distribution pipe, consisting of ten inlets equally spaced, was installed in pone one for equal sludge distribution in the pond. The new type of inlet was designed to accelerate sludge digestion in the pond, and hence to prevent "sour" conditions. Sludge recirculation lines along with a pump were also installed in this pond. It is intended to use the digested sludge as seed material for raw sewage. A sketch of the new distribution line is shown in figure 14.

Immediately after the installation of the distribution pipe, winter of 1963-64, ponds one and four were the two short detention ponds in use. The new design gave satisfactory results as indicated by observations. Odors which were dominant the previous year had disappeared. A sample on March 3, 1964 gave the following biochemical oxygen demands: pond one - 156 ppm and pond four - 126 ppm. The overall B.O.D. reduction for the two short detention ponds was 56.0%. Although the degree of treatment was in the expected range, the liquid of both ponds had a reddish-brown color between December 1963 and March 12, 1964. However, after March 12, 1964, at which time the meat packing plant suspended operations, the reddish-brown color disappeared, and the ponds were back to the normal gray color. It seems the meat packing plant wastes had caused the reddish - brown color, and not other physical or chemical factors as speculated at first.

One temperature and two sludge surveys were conducted in pond one. These topics have been discussed in a separate section.

Plan of Medicine Hat Sewage Ponds



Scale: 1" = 500'

Ponds 1, 2, 3, & 4:

Capacity: 6 million gals. each @ 10'
Area: 2.2 acres each

Pond 5

Capacity: 55 million gals. @ 6.5'
Area: 31 acres

Figure 13

Table 8A

SEWAGE POND STUDY

Location: Medicine Hat - Raw Sewage — Sampling Point: Balmoral Lift Station

Date		Jan. 17/62	Feb. 14	Mar. 21	April 25	May 23/62	Oct. 31/62	Sept. 18/63
Time								
Wind, mphr.								
Light, fc.								
pH		7.8	7.35	7.75	6.9	7.25	7.35	7.1
D.O. ppm								
Temperature °C.								
Alkalinity, ppm	pp	-	-	-	-	-	-	-
	MO	265	255	246	245	238	260	225
Odor, T.O.N.								250
B.O.D., ppm		132	590	174	328	157	212	145
Nitrogens, ppm	Total							
	Ammonia	34	40	32	30	27	19.0	15.5
	Nitrite							
	Nitrate							
Total Solids ppm	Total	662	1053	591	849	678	744	898
	Volatile	323	681	258	404	244	284	282
Suspended Solids, ppm	Total	150	172	174	304	134	178	178
	Volatile	132	160	152	206	124	158	170
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Total Sulfur - ppm								26
Ice, feet								
Liquid, feet								
Overflow								

SEWAGE POND STUDY

Location Medicine Hat - Raw Sewage Sampling Point Balmoral Lift Station

Date		Jan. 8/64	Jan. 22/64	Feb. 12/64
Time				
Wind, mphr.				
Light, fc.				
pH				
D.O. ppm				
Temperature °C.				
Alkalinity, ppm	pp			
	MO			
Odor, T.O.N.				
B.O.D., ppm		205	194	201
Nitrogens, ppm	Total			
	Ammonia			
	Nitrite			
	Nitrate			
Total Solids ppm	Total			
	Volatile			
Suspended Solids, ppm	Total			
	Volatile			
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet				
Liquid, feet				
Overflow				

Table 8B

SEWAGE POND STUDY

Location Medicine Hat - Raw Sewage — Sampling Point Crescent Hts. Lift Station

Date		Jan. 17/62	Feb. 14	Mar. 21	April 25	May 23	Oct. 31/62	Sept. 18/63	Jan. 16/64
Time									
Wind, mphr.									
Light; fo.									
pH		7.6	7.35	7.8	7.3	7.25	7.40	7.35	
D.O. ppm									
Temperature °C.									
Alkalinity, ppm	pp	-	-	-	-	-	-	-	
	MO	285	240	246	260	240	245	315	
Odor, T.O.N.						750		200	
B.O.D., ppm		88	281	144	184	202	111	167	144
Nitrogens, ppm	Total								
	Ammonia	40	37	33	34	36	16.0	19.0	
	Nitrite								
	Nitrate								
Total Solids ppm	Total	807	819	661	633	628	608	695	
	Volatile	296	352	279	270	255	213	267	
Suspended Solids, ppm	Total	152	254	194	190	254	136	90	
	Volatile	136	226	136	154	226	124	78	
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Total Sulfur								35.0	
Ice, feet									
Liquid, feet									
Overflow									

Table 8C

SEWAGE POND STUDY

Location: Medicine Hat - Raw Sewage — Sampling Point: Purmal Lift Station

Date		Jan. 17/62	Feb. 14	Mar. 21	April 25/62	Oct. 31/62	Sept. 18/63	Jan. 8/64	Jan. 22/64
Time									
Wind, mphr.									
Light, fc.									
pH		7.6	7.65	7.75	7.5	7.35	6.7		
D.O. ppm									
Temperature °C									
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	285	270	246	270	300	250		
Odor, T.O.N.							400		
B.O.D., ppm		73	131	89	108	508	551	454	380
Nitrogens, ppm	Total								
	Ammonia	28	33	21	24	19.0	14.0		
	Nitrite								
	Nitrate								
Total Solids ppm	Total	771	838	736	819	1275	1546		
	Volatile	281	337	252	261	675	942		
Suspended Solids, ppm	Total	126	206	118	64	288	476		
	Volatile	116	202	102	60	264	460		
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Total Sulfur - ppm							71		
Ice, feet									
Liquid, feet									
Overflow									

Table 8D

SEWAGE POND STUDY

Location: Medicine Hat Pond No.1 — Sampling Point: AT OVERFLOWS

Date		Jan. 17/62	Feb. 14	Mar. 21	April 25	May 23/62	Oct. 15/62	June 7/63	Aug. 6/63
Time							3:30 pm		
Wind, mphr.							Calm		
Light, fc.							Sunny		
pH		7.35	7.35	7.35	7.25	7.30	6.8	7.1	7.45
D.O. ppm							-		-
Temperature °C							14	18	
Alkalinity, ppm	pp M	- 270	- 245	- 247	- 240	- 260	- 265	- 373	- 455
Odor, T.O.N						500	500	500	300
B.O.D., ppm		21	110	70	100	107	112	168	57
Nitrogens, ppm	Total								
	Ammonia	24	28				36	35.5	25.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	571	552	511	606	670	790	809	795
	Volatile	192	161	158	172	188	189	351	243
Suspended Solids, ppm	Total	48	70	33	32	57	62	226	144
	Volatile	44	70	31	31	57	47	180	94
Chlorides ppm									180
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Pond Operation									
Ice, feet								Series	Parallel
Liquid, feet							9.3		
Overflow							Yes		

SEWAGE POND STUDY

Location Medicine Hat Pond No. 1 Sampling Point

Date		Aug. 20/63	Sept. 18	Mar. 3/64
Time				10:45 am
Wind, mphr.				Calm
Light, fc.				Cloudy
pH		7.25	7.6	6.9
D.O. ppm				
Temperature °C.				6
Alkalinity, ppm	pp	-	-	-
	MO	465	455	375
Odor, T.O.N.		Slight H_2S 500	500	20
B.O.D., ppm		34	24	156
Nitrogens, ppm	Total Ammonia	24.8	45.5	15
	Nitrite			
	Nitrate			
Total Solids ppm	Total	763	642	703
	Volatile	243	167	237
Suspended Solids, ppm	Total	100	22	68
	Volatile	50	20	60
Chlorides ppm				
Sulfates ppm		128		
Phosphates ppm				
Detergents ppm				
Pond Operation		Parallel	PARALLEL	
Ice, feet				
Liquid, feet				
Overflow				

NOTE "ACTI-ZEME" USED BETWEEN AUG 6/63 TO SEPT. 18/63

Table 8F

SEWAGE POND STUDY

Location Medicine Hat Pond No. 2 Sampling Point AT OVERFLOWS

Date		Jan. 17/62	Feb. 14	Mar. 21	April 25	May 23	Oct. 15/62	June 7/63	Aug. 6
Time							3:45 pm		
Wind, mphr.							Calm		
Light, fc.							Sunny		
pH		7.3	7.4	7.4	7.35	7.45	7.10	7.0	7.35
D.O. ppm							-		
Temperature °C							13	18	
Alkalinity ppm	pp	-	-	-	-	-	-	-	-
	MO	270	245	248	225	280	335	351	485
Odor, T.O.N.						500	500	600	500
B.O.D., ppm		20	88	49	67	68	111	375	73
Nitrogens, ppm	Total Ammonia	23	33				37	37.0	18.3
	Nitrite								
	Soluble								
Total Solids ppm	Total	575	520	516	564	662	914	1248	844
	Volatile	170	162	163	154	177	212	718	304
Suspended Solids, ppm	Total	42	36	24	13	23	138	696	166
	Volatile	42	34	24	13	23	46	554	146
Chlorides ppm									105
Sulfates ppm									68.0
[redacted]		OILS & GREASES - ppm							
Detergents ppm									
Pond Operation								Series	Parallel
Ice, feet									
Liquid, feet							9.25		
Overflow							Yes	Yes	

SEWAGE POND STUDY

Location: Medicine Hat Pond No. 2 — Sampling Point:

Date		Aug. 20/63	Sept. 18/63
Time			
Wind, mphr.			
Light, fo.			
pH		7.25	7.6
D.O. ppm			
Temperature °C.		18	
Alkalinity, ppm	pp	-	-
	MO	490	470
Odor, T.O.N.		400	400
B.O.D., ppm		41	11
Nitrogens, ppm	Total		
	Ammonia	24.0	26.0
	Nitrite		
	Nitrate		
Total Solids ppm	Total	801	652
	Volatile	269	136
Suspended Solids, ppm	Total	150	18
	Volatile	124	10
Chlorides ppm			
Sulfates ppm		100	
Phosphates ppm			
Detergents ppm			
POND OPERATION		PARALLEL	PARALLEL
Ice, feet			
Liquid, feet			
Overflow			

Table 8F

SEWAGE POND STUDY

Location Medicine Hat Pond No. 3 Sampling Point AT OVERFLOWS

Date		Jan. 17/62	Feb. 14	Mar.21	April 25	May 23	Oct. 15/62	Aug. 6/63	Aug. 20
Time							4:00 pm		
Wind, mphr.							Calm		
Light, fo.							Sunny		
pH		7.25	7.4	7.25	7.5	7.65	7.6	7.55	7.35
D.O. ppm							-		
Temperature °C.							14		
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	275	240	248	245	285	380	475	445
Odor, T.O.N.						500	400	250	200
B.O.D., ppm		4	76	44	55	52	87	28	18
Nitrogens, ppm	Total Ammonia	23	28				43	18.0	19.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	570	518	490	555	664	843	697	715
	Volatile	162	146	139	142	182	107	250	228
Suspended Solids, ppm	Total	40	26	21	11	31	57	36	56
	Volatile	34	24	21	11	31	27	34	44
Chlorides ppm								107	140
Sulfates ppm								19.3	
[redacted]	OILS & GREASES - PPM								
Detergents ppm									
Pond Operation								Parallel	Parallel
Ice, feet									
Liquid, feet							Yes	Yes	Yes
Overflow									

Table 8G

SEWAGE POND STUDY

Location: Medicine Hat Pond No. 4 — Sampling Point: At Overflows

Date		Mar. 21/62	April 25	May 23	Oct. 15/62	Aug. 6/63	Aug. 20	Mar. 3/64
Time					4:10 pm			10:30 am
Wind, mphr.					Calm			Calm
Light, fo.					Sunny			Cloudy
pH		7.35	7.4	7.75	7.65	7.55	7.4	6.9
D.O. ppm								
Temperature °C					14			7.0
Alkalinity, ppm	pp	-	-	-	-	-	-	-
	MO	243	240	290	375	460	445	375
Odor, T.O.N.					400	200	100	20
B.O.D., ppm		37	54	43	77	13	13	126
Nitrogens, ppm	Total Ammonia				44.6	14.5	21.5	23.0
	Nitrite							
	Nitrate							
Total Solids ppm	Total	447	579	648	784	682	727	682
	Volatile	125	152	173	205	240	189	235
Suspended Solids, ppm	Total	14	11	28	55	28	32	60
	Volatile	0	11	28	44	28	20	56
Chlorides ppm								
Sulfates ppm						130	143	
Phosphates ppm								
Detergents ppm								
Pond Operation						Parallel	Parallel	
Ice, feet								
Liquid, feet								
Overflow					Yes			Yes

RED DEER

The Red Deer lagoons, consisting of five equal size short detention ponds, began operation in the fall of 1961. These ponds operate in series with a continuous overflow to the Red Deer River throughout the year. This system serves a population of 23,000 and the following major industries:

(a) two dairies
(b) a milk condensery plant
(c) dairy product plant
(d) a brewery
(e) poultry processing plant
(f) a meat packing plant

All five ponds were operated in series from the fall of 1961 to July 23, 1963. After July 23, 1963, the first pond was by-passed giving a four pond system. A limited number of samples were obtained when the four ponds were in operation.

Based on average B.O.D. results, a four pond unit had a winter B.O.D. reduction of 63.4% as compared to 52.0% for a five pond system. Furthermore, in a five pond set-up a negative B.O.D. reduction or a rise in B.O.D. concentration occurred in the fourth pond while in the four pond unit B.O.D. decreased with detention time. During the summer the five pond unit had a B.O.D. reduction of 75.0% as to 73.6% (from one sample) for four ponds in series.

By comparing the two types of systems, four and five ponds, the shorter detention period has produced a slightly better performance in terms of B.O.D. The average sewage flow increased during the use of the four pond unit, thus decreasing the detention time in each cell. The B.O.D. reduced in the first cell was 27.8% in the five pond system as compared to 39.0% for the four pond set-up. The B.O.D. reductions for the first two ponds were 45.8% for five ponds in series and 52.1% for the four pond system. However, after the third pond, the additional treatment provided by each successive pond in both types of set-ups varied only by a small amount.

During the investigation period a number of pH readings in the acid state, all occurring in the winter, were obtained from the supernatant of the ponds. The acid condition during the winter of 1962-63 and 1964 did not have any serious effects on the treatment or create any nuisance.

Suspended solids fluctuated from sample to sample with a general peak range in 1963 for the first three ponds. In the fourth and fifth ponds, the suspended solids showed no definite trends. Overall suspended solids removal during the winter were slightly higher for the five pond unit as compared to a four pond unit; 86.0% to 83.9%.

Ammonia-nitrogen in all ponds reached their maximum values in the winter and minimas in the summer with the range being from 15 ppm to 50 ppm.

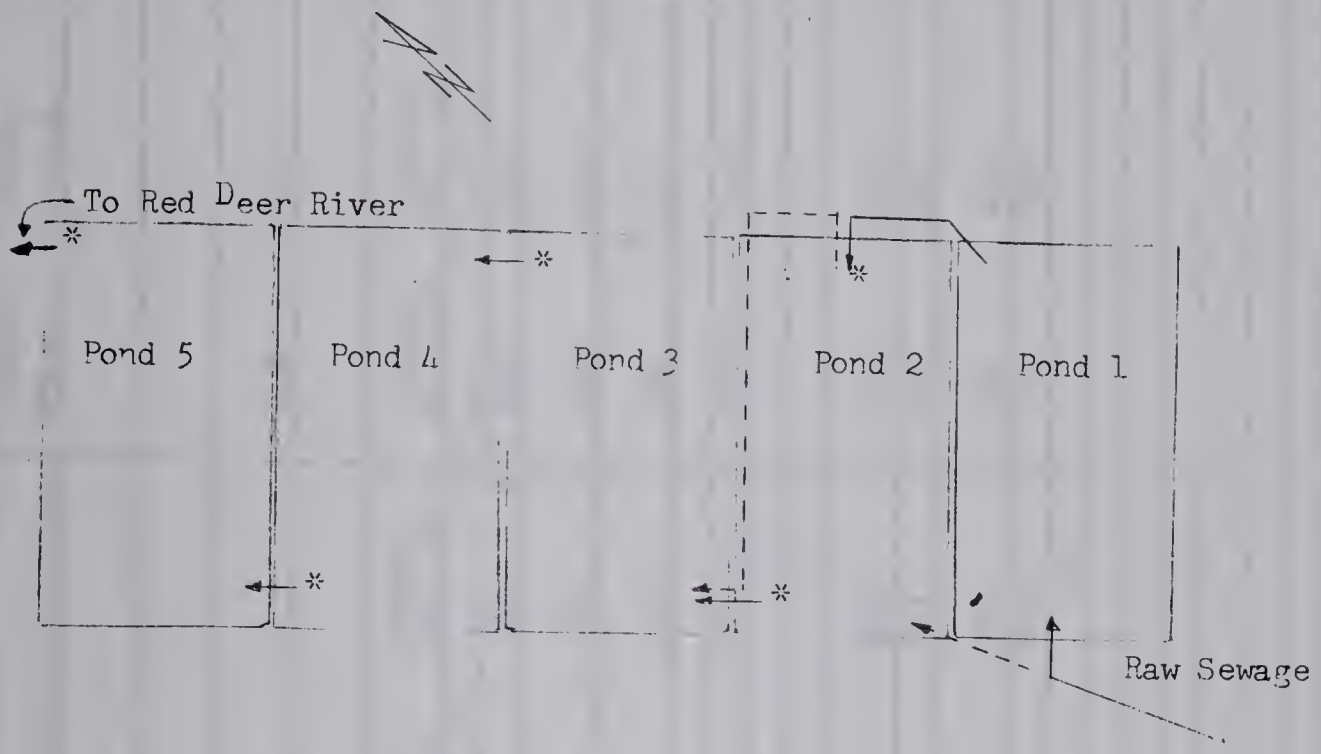
Total solids and alkalinity showed no definite trends throughout the system.

Odors near the ponds ranged from moderate to high concentrations throughout the year. However, the odors were not detectable at distances greater than several hundred feet from the system.

During the winter the first pond of both set-ups were free of ice. The second pond had a slight ice cover near the effluent point during the coldest portion of winter.

Temperature and sludge surveys have been conducted on this system and are discussed in a separate section of this report.

PLAN OF RED DEER SEWAGE PONDS



Scale 1" = 200'

* - Sampling locations

All Ponds same Size and Capacity, each at:-
- 1.18 Acres
- 3.11 Million Gal. @ 10 Ft. Depth

Flow Pattern:

(a) Oct. 1961 to July 23, 1963

Raw → Pond 1 → 2 → 3 → 4 → 5

(b) July 23, 1963 to July 8, 1964

Raw → Pond 2 → 3 → 4 → 5

Figure 15

Location Red Deer Raw Sewage — Sampling Point Lift Station

		October - 1963					May - 1964		
Date		9 - 10	10	10 - 11	11	10-11	12	13	14
Time		9a.m.-2a.m.	3a.m.-8a.m.	9a.m.-2a.m	3a.m.-8a.m.	9a.m.-8a.m.	11a.m.-8p.m.	8a.m.-8p.m.	8a.m.-8p.m.
Wind, mphr.									
Light, fo.									
pH Lab.		7.15	7.25	7.75	8.15	7.65	6.9	6.85	7.35
D.O. ppm									
Temperature °C.		Varied 14 - 18	Varied 15 - 18	Varied 15 - 18	Varied 14 - 18	Varied 14 - 18	Varied 14 - 17	Varied 13 - 17	Varied 13 - 17
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	360	255	330	275	315	248	320	300
Odor, T.O.N.		200	200	200	100	200	200	200	300
B.O.D., ppm		447	212	300	135	335	394	523	473
Nitrogens, ppm	Total Ammonia	21.5	19.0	28.5	26.5	27.5	37.5	34.0	32.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	885	645	1055	676	926	1143	1031	953
	Volatile	480	264	634	336	571	566	523	516
Suspended Solids, ppm	Total	374	164	332	132	298	358	420	536
	Volatile	280	98	280	88	240	303	324	464
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet									
Liquid, feet									
Overflow									

SEWAGE POND STUDY

Location Red Deer Raw Sewage — Sampling Point Lift Station

		June 1962			
Date		26 - 7	27 - 8	28 - 9	Feb.20/63
Time					7a.m.-11p.m.
Wind, mphr.					
Light, fc.					
pH		7.15	7.45	7.45	7.3
D.O. ppm					
Temperature °C.		Varied 17 - 20	Varied 17 - 19	Varied 18 - 21	Varied 10 - 15
Alkalinity, ppm	pp	--	--	--	--
	MO	207	251	247	270
Odor, T.O.N.					300
B.O.D., ppm	filtered	186	182	232	—
	unfiltered	338	383	422	600
Nitrogens, ppm	Total				
	Ammonia	16.0	17.5	14.5	23.5
	Nitrite				
	Nitrate				
Total Solids ppm	Total	663	800	846	937
	Volatile	321	449	459	505
Suspended Solids, ppm	Total	--	214	228	644
	Volatile	--	174	162	508
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet					
Liquid, feet					
Overflow					

SEWAGE POND STUDY

Location Red Deer Pond #1 Sampling Point Manhole to No. 2

Date		Oct. 21/61	Nov. 15	Dec. 13/61	Jan. 10/62	Feb. 7	March 8	April 4	May 2 /62
Time				1:00p.m.	2:00p.m.	1:00p.m.	11:45a.m.	1:20p.m.	2:35p.m.
Wind, mphr.				Calm	Calm	10	5	20	15
Light, fo.				1000+	1000+	1000+	1000+	1000+	1000+
pH		6.8	6.55	6.9	7.2	7.2	6.7	6.8	6.9
D.O. ppm				~~NIL~~	NIL	NIL	NIL	NIL	NIL
Temperature °C.				3.0	3.0	2.0	2.0	10.0	13.0
Alkalinity, ppm	pp MO	234	210	-- 205	-- 230	-- 225	-- 200	-- 255	-- 275
Odor, T.O.N.				10000(?)	2000	3000	6000	500	200
B.O.D., ppm		274	267	223	200	230	236	238	259
Nitrogens, ppm	Total			42.0	43.5	24.0	39.5	47.4	42.5
	Ammonia			25.5	41.0	33.0	35.0	40.0	21.0
	Nitrite			0.010	NIL	0.002	NIL	0.020	0.005
	Nitrate			0.10	0.250	0.325	0.175	0.300	0.125
Total Solids ppm	Total	619	666	782	550	480	614	576	573
	Volatile	249	315	378	254	191	251	211	209
Suspended Solids, ppm	Total	59	65	72	70	57	122	55	64
	Volatile	49	64	66	70	70	110	47	64
Chlorides ppm				62	44	74	74	58	62
Sulfates ppm					90	82	90	90	82
Phosphates ppm				33	34	28	30	28	30
Detergents ppm				8.3	7.3	5.3	6.6	6.5	7.4
Ice, feet				--	--	--	--	--	--
Liquid, feet				4	4	4	4	4	4
Overflow									

SEWAGE POND STUDY

Location: Deer Pond 1 — Sampling Point: Manhole to No. 2

		July 26/62	Sept. 6	Nov. 14	Dec. 12	Jan. 16	Feb. 13	Mar.20/63	April 17
Time		2:25p.m.	1:00p.m.	2:15p.m.	1:35p.m.	2:00p.m.	4:10p.m.	1:45p.m.	3:40p.m.
Wind, mphr.		Calm	Calm	Calm	Calm	5	Calm	10	10
Light, fo.		Sunny	900	350	1000+	500	500	1000+	1000+
pH		6.9	7.0	7.0	6.9	7.2	7.15	7.1	7.1
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		21	17	9	5	2	10	5	10
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	260	225	345	170	200	270	275	230
Odor, T.O.N.		--	1000	1000	500	2000	4000	1000	1000
B.O.D., ppm		200	220	207	92	402	401	240	230
Nitrogens, ppm	Total								
	Ammonia	24.2	41.	33.2	2.1	34.2	30.5	24.5	23
	Nitrite								
	Nitrate								
Total Solids ppm	Total	344	500	753	764	462	687	720	534
	Volatile	247	240	315	340	237	320	307	230
Suspended Solids, ppm	Total	2	70	184	152	308	240	760	126
	Volatile	2	70	114	140	104	124	105	94
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		--	--	--	--	--	--	--	--
Liquid, feet Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9B

SEWAGE POND STUDY

Location Red Deer Pond No. 1 Sampling Point -Composite Samples

		June - 1962							
Date		26 - 7	27 - 8	28 - 9	Feb.20/63				
Time		19 HRS	24 HRS	24 HRS	7a.m.-11p.m.				
Wind, mphr.									
Light, fo.									
pH		7.25	7.25	7.45	7.35				
D.O. ppm									
Temperature °C.		Varied 17 - 20	Varied 17 - 20	Varied 18 - 21	Varied 8 - 10				
Alkalinity, ppm	pp	--	--	--	--				
	MO	238	238	249	275				
Odor, T.O.N.					1500				
B.O.D., ppm	filtered	182	152	228					
	unfiltered	233	226	279	384				
Nitrogens, ppm	Total Ammonia	20.5	20.5	13	31.8				
	Nitrite								
	Nitrate								
Total Solids ppm	Total	543	551	623	677				
	Volatile	235	248	273	293				
Suspended Solids, ppm	Total	44	79	80	176				
	Volatile	36	75	59	142				
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Sampling Interval - Hrs.		2	2	2	2				
Ice, feet									
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes				

SEWAGE POND STUDY

Location Red Deer Pond #2 — Sampling Point Manhole to Pond No. 3

Date		Oct. 26/61	Nov. 15	Dec. 13/61	Jan. 10/62	Feb. 7	March 8	April 4	May 2/62
Time				12:55p.m.	1:10p.m.	12:30p.m.	10:40a.m.	12:45p.m.	2:25p.m.
Wind, mphr.				Calm	Calm	10	5	20	20
Light, fo.				1000+	1000+	1000+	1000 +	1000+	1000+
pH		6.85	6.8	7.0	7.2	7.1	6.8	6.9	6.9
D.O. ppm				NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.				3.0	3.0	1.5	1.5	10.0	12.0
Alkalinity, ppm	pp M O	— 234	— 240	-- 225	-- 240	-- 225	-- 200	-- 260	-- 300
Odor, T.O.N.				(?)8000	2000	1000	4000	800	400
B.O.D., ppm		249	231	145	152	225	212	221	227
Nitrogens, ppm	Total			36.7	37.0	--	42.6	39.8	41.5
	Ammonia	43.5		38.5	37.0	47.0	37.0	38.0	22.5
	Nitrite			0.015	NIL	0.005	NIL	0.030	0.004
	Nitrate			0.163	0.445	0.550	0.200	0.300	0.125
Total Solids ppm	Total	605	585	603	580	600	532	566	540
	Volatile	237	298	270	210	226	216	211	230
Suspended Solids, ppm	Total	66	26	33	59	54	84	69	50
	Volatile	58	26	25	52	54	78	53	50
Chlorides ppm				54	48	108	54	58	52
Sulfates ppm					90	80	98	55	52
Phosphates ppm				33	37	29	36	38	31
Detergents ppm				9.2	9.5	9.1	8.2	8.8	8.6
Ice, feet				--	0.2	0.2	--	--	
Liquid, feet				--	3.0	5.0	4	4	4
Overflow				Yes	Yes	Yes	Yes	Yes	Yes

SULA

SEWAGE POND STUDY

Location Red Deer Pond #2 Sampling Point Manhole to Pond No. 3

Date		July 26/62	Sept. 6	Nov. 14	Dec. 12	Jan. 16/63	FEb. 13	Mar. 20/63	April 17
Time		2:30p.m.	12:55p.m.	2:10p.m.	1:30p.m.	2:05p.m.	4:05p.m.	1:40p.m.	3:35p.m.
Wind, mphr.		Calm	Calm	Calm	Calm	5	Calm	10	10
Light, fc.		Sunny	900	350	1000+	500	500	1000+	1000+
pH		7.2	7.0	6.9	6.95	7.1	7.1	7.0	7.1
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		21	18	7	5	2	6	9	9
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	270	265	295	305	275	255	250	255
Odor, T.O.N.		--	800	500	500	1000	2000	1000	1000
B.O.D., ppm		167	193	252	255	279	313	251	200
Nitrogens, ppm	Total								
	Ammonia	22	36.5	35.3	31	31.5	37.5	26	34.0
	Nitrite								
	Nitrate								
Total Solids ppm	Total	545	553	623	616	664	634	579	534
	Volatile	226	209	246	246	286	266	251	203
Suspended Solids, ppm	Total	64	51	136	88	136	86	142	106
	Volatile	64	49	78	44	126	85	122	94
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		--	--	--	--	½ of pond area		--	--
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Red Deer Pond #2 Sampling Point Manhole to Pond No. 3

Date		Sept. 11	Jan. 8/64	Jan. 29	April 8/64
Time		2:30p.m.	1:10p.m.	2:30p.m.	1:00p.m.
Wind, mphr.		Calm	Calm	Calm	Calm
Light, fo.		800	1000+	1000+	1000+
pH		7.15	7.0	6.95	6.9
D.O. ppm		NIL	NIL	NIL	NIL
Temperature °C.		17	8	10	12
Alkalinity, ppm	pp	--	--	--	--
	MO	340	315	335	305
Odor, T.O.N.		1000	500	500	200
B.O.D., ppm		182	215	215	218
Nitrogens, ppm	Total Ammonia	24.5	33.5	39.3	30.7
	Nitrite				
	Nitrate				
Total Solids ppm	Total	672	625	730	655
	Volatile	275	273	324	262
Suspended Solids, ppm	Total	208	146	140	158
	Volatile	172	134	126	86
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet		--	-	--	--
Liquid, feet					
Overflow		Yes	Yes	Yes	Yes

Table 9C

SEWAGE POND STUDY

Location: Red Deer Pond No. 2 — Sampling Point: Composite Samples

June 1962

		26-27	27-28	28-29	Feb. 20/63	Oct. 9-10/63
Date						
Time		19 Hrs	24 Hrs.	24 Hrs	7:00 am - 11:00 pm	9:00 am - 8:00 am
Wind, mphr.						
Light, fo.						
pH		7.05	7.55	7.55	7.35	7.10
D.O. ppm		Nil	Nil	Nil		Nil
Temperature °C.		Varied 18 - 21	Varied 17 - 20	Varied 18 - 21	Varied 4 - 6	
Alkalinity, ppm	pp	-	-	-	-	-
	MO	226	260	278	290	335
Odor, T.O.N.					1500	200
B.O.D., ppm		194	184	210	284	161
Nitrogens, ppm	Total					
	Ammonia	23	22	20	32	28.0
	Nitrite					
	Nitrate					
Total Solids ppm	Total	586	522	565	647	650
	Volatile	232	205	239	252	261
Suspended Solids, ppm	Total	50	74	70	96	146
	Volatile	34	72	52	74	84
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Sampling Interval - Hrs.		2	2	2	2	6
Ice, feet						
Liquid, feet						
Overflow		Yes	Yes	Yes	Yes	Yes

Table 9D

SEWAGE POND STUDY

Location Red Deer Pond #3 Sampling Point Outfall

Date		Oct.26/61	Nov. 15	Dec. 13	Jan. 10/62	Feb. 7	March 8	April 4	May 2/62
Time				12:45p.m.	1:45p.m.	12:55p.m.	11:30a.m.	1:15p.m.	2:15p.m.
Wind, mphr.				Calm	Calm	10	5	20	20
Light, fo.				1000+	1000+	1000+	1000+	1000+	1000+
pH		6.9	6.9	7.0	7.1	7.2	6.7	7.0	6.8
D.O. ppm				NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.				3.0	2.5	1.5	1.5	9.0	11.0
Alkalinity, ppm	pp	–	–	--	--	--	--	--	--
	MO	235	240	285	235	225	240	275	275
Odor, T.O.N.				4000	1000	2000	7000	600	400
B.O.D., ppm		216	238	123	126	159	199	183	247
Nitrogens, ppm	Total			38.4	43.4	--	45.0	38.4	39.0
	Ammonia	51		30.0	40.5	47.0	38.0	36.0	21.9
	Nitrite			0.008	NIL	0.002	NIL	0.020	0.005
	Nitrate			0.050	0.800	0.300	0.175	0.283	0.025
Total Solids ppm	Total	579	632	570	553	580	534	553	656
	Volatile	202	298	211	205	196	219	203	252
Suspended Solids, ppm	Total	47	56	49	29	51	78	58	39
	Volatile	39	50	49	29	51	78	48	39
Chlorides ppm				76	46	82	52	56	50
Sulfates ppm					100	75	94	56	52
Phosphates ppm				36	36	34	37	33	30
Detergents ppm				7.8	8.5	7.8	7.8	7.7	7.5
Ice, feet				0.3	0.3	0.3	--	--	--
Liquid, feet				3.0	3.0	5.0	--	5.0	5.0
Overflow				Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Red Deer Pond #3 Sampling Point Outfall

Date	July 25/62	Sept. 6	Nov. 14	Dec. 12	Jan. 16/63	Feb. 13	Mar.20/63	April 17/63
Time	2:20p.m.	12:50p.m.	2:05	1:25p.m.	1:55p.m.	3:50p.m.	1:30p.m.	3:30p.m.
Wind, mphr.	Calm	Calm	Calm	Calm	5	Calm	10	10
Light, fo.	Sunny	900	350	1000+	500	500	1000+	1000+
pH	7.3	7.15	6.9	7.0	7.0	7.2	7.05	7.3
D.O. ppm	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.	21	18	6	2	2	4	9	9
Alkalinity, ppm pp	--	--	--	--	--	--	--	--
Alkalinity, ppm MO	270	285	335	315	280	270	265	275
Odor, T.O.N.	—	500	200	300	800	2000	800	800
B.O.D., ppm	138	146	198	255	233	285	243	208
Nitrogens, ppm — Total Ammonia	22.5	36	36	31.5	27	35	27	32.5
Nitrogens, ppm — Nitrite								
Nitrogens, ppm — Nitrate								
Total Solids ppm — Total	535	526	606	632	609	636	572	524
Total Solids ppm — Volatile	239	210	253	250	249	240	237	193
Suspended Solids, ppm — Total	37	88	92	64	56	90	58	100
Suspended Solids, ppm — Volatile	32	64	64	59	50	90	56	92
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet	--	--	--	0.3	0.5		--	--
Liquid, feet								
Overflow	Yes	Yes	Yes	Yes	YEs	Yes	Yes	Yes

SEWAGE POND STUDY

Location Red Deer Pond #3 Sampling Point Outfall

Date		Sept. 11	Jan.8/64	Jan.29/64	April8
Time		2:20p.m.	12:50p.m.	2:20p.m.	1:10p.m.
Wind, mphr.		Calm	Calm	Calm	Calm
Light, fo.		800	1000+	1000+	1000+
pH		7.15	6.9	6.90	6.9
D.O. ppm		NIL	NIL	NIL	NIL
Temperature °C.		17	6	7	10
Alkalinity, ppm	pp	--	--	--	--
	MO	325	310	340	300
Odor, T.O.N.		600	200	400	200
B.O.D., ppm		177	170	168	130
Nitrogens, ppm	Total Ammonia	26	35.5	39.0	31.5
	Nitrite				
	Nitrate				
Total Solids ppm	Total	541	582	620	523
	Volatile	206	224	231	184
Suspended Solids, ppm	Total	114	100	64	102
	Volatile	110	96	60	48
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet		--	--	--	--
Liquid, feet					
Overflow		Yes	Yes	Yes	Yes

Table 9D

SEWAGE POND STUDY

Location: Red Deer Pond No. 3 — Sampling Point: Composite Samples

Date	June 1962 26-27	June 1962 27-28	June 1962 28-29	Feb. 20/63	Oct. 9-10/63
Time	24 Hrs	24 Hrs	24 Hrs.	7:00 am - 11:00 pm	9:00 am - 8:00 am
Wind, mphr.					
Light, fo.					
pH	7.30	7.60	7.60	7.4	7.2
D.O. ppm	Nil	Nil	Nil		Nil
Temperature °C.	Varied 18 - 22	Varied 17 - 20	Varied 18 - 20	Varied 4 - 5	
Alkalinity, ppm MO pp	-	-	-	-	-
Alkalinity, ppm MO	266	273	273	280	350
Odor, T.O.N.				800	200
B.O.D., ppm	140	152	199	269	119
Nitrogens, ppm — Total Ammonia	22	24	21	33	33.5
Nitrogens, ppm — Nitrite					
Nitrogens, ppm — Nitrate					
Total Solids ppm — Total	491	514	538	633	583
Total Solids ppm — Volatile	213	228	219	240	210
Suspended Solids, ppm — Total	56	72	68	82	96
Suspended Solids, ppm — Volatile	36	64	42	60	48
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Sampling Interval - Hrs.	2	2	2	2	6
Ice, feet					
Liquid, feet					
Overflow	Yes	Yes	Yes	Yes	Yes

Table 9E

SEWAGE POND STUDY

Location: Red Deer Pond #4 — Sampling Point: Outfall

Date		Oct. 26	Nov.15/61	Dec. 13	Jan. 10/62	Feb. 7	March 8	April 4	May 2 /62
Time				12:30p.m.	1:30p.m.	12:45p.m.	11:00a.m.	12:55p.m.	2:30p.m.
Wind, mphr.				Calm	Calm	10	5	20	20
Light, fo.				1000	1000+	1000+	1000+	1000+	1000+
pH		6.95	6.9	7.0	7.1	6.9	6.5	7.2	7.1
D.O. ppm				NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C				1.5	1.5	0.8	0.7	9.0	11.0
Alkalinity, ppm MO pp		245	240	240	230	210	195	275	315
Odo. T.O.N.				4000	500	2000	5000	200	300
B.O.D., ppm		200	213	--	137	162	189	176	254
Nitrogens, ppm	Total			40.4	35.0	--	42.9	32.0	36.4
	Ammonia	44		30.0	41.0	44.0	39.0	38.0	20.5
	Nitrite			0.006	NIL	NIL	NIL	0.020	0.005
	Nitrate			0.050	0.263	0.325	0.400	0.205	0.075
Total Solids ppm	Total	540	562	573	527	577	555	645	614
	Volatile	189	220	219	203	197	219	312	234
Suspended Solids, ppm	Total	39	33	75	35	40	78	68	35
	Volatile	31	33	75	35	40	78	57	35
Chlorides ppm				56	42	110	54	58	50
Sulfates ppm					77	97	95	45	55
Phosphates ppm				37	31	35	31	30	30
Detergents ppm				5.5	7.8	8.3	8.1	8.0	6.6
Ice, feet				0.6	0.5	0.4	--	--	--
Liquid, feet				4.0	3.0	5.0	5.0	5.0	5.0
Overflow				Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Red Deer Pond #4 Sampling Point Outfall

Date		July26/62	Sept. 6	Nov. 14	Dec. 12	Jan. 16/63	Feb. 13	Mar. 20/63	April 17
Time		2:15p.m.	12:45	2:00p.m.	1:20p.m.	1:40p.m.	4:00p.m.	1:20p.m.	3:20p.m.
Wind, mphr.		Calm	Calm	Calm	Calm	5	Calm	10	10
Light, fo.		Sunny	900	350	1000+	500	500	1000+	1000+
pH		7.45	7.15	7.0	6.95	7.0	7.15	7.1	7.15
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		20	17	6	3	2	3	7	9
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	230	270	315	335	285	270	270	290
Odor, T.O.N.		--	60	150	400	500	1000	500	800
B.O.D., ppm		116	120	193	241	249	278	247	203
Nitrogens, ppm	Total Ammonia	14.5	35	34.5	31	35.5	35.5	29	33.2
	Nitrite								
	Nitrate								
Total Solids ppm	Total	615	477	582	640	598	596	610	556
	Volatile	317	257	215	265	222	231	239	200
Suspended Solids, ppm	Total	36	69	78	69	100	52	38	66
	Volatile	25	69	54	--	94	52	38	84
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		--	--	--	0.3	0.5	less than 0.5	--	--
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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SEWAGE POND STUDY

Location Red Deer Pond #4 Sampling Point Outfall

Date		Sept. 11/63	Jan. 8/64	Jan. 29	April 8/64
Time		2:10p.m.	12:30p.m.	2:15 pm	1:20 pm
Wind, mphr.		Calm	Calm	Calm	Calm
Light, fo.		800	1000+	1000+	1000+
pH		7.15	7.20	6.9	6.95
D.O. ppm		NIL	NIL	NIL	NIL
Temperature °C.		17	4	5	9
Alkalinity, ppm	pp	--	--	--	--
	MO	350	350	330	315
Odor, T.O.N.		700	200	300	200
B.O.D., ppm		112	149	138	124
Nitrogens, ppm	Total Ammonia	26	40.2	38	31.5
	Nitrite				
	Nitrate				
Total Solids ppm	Total	561	525	578	525
	Volatile	190	185	206	177
Suspended Solids, ppm	Total	144	56	48	61
	Volatile	126	56	48	50
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet		--	half opened	0.5	--
Liquid, feet					
Overflow		Yes	Yes	Yes	Yes

Table

SEWAGE POND STUDY

Location: Red Deer Pond No. 4 — Sampling Point: Composite Samples

	June 1962				
Date	26-27	27-28	28-29	Feb. 20/63	Oct. 9-10/63
Time	18 Hrs.	24 Hrs.	24 Hrs.	7:00 am - 11:00 pm	9:00 am - 8:00 am
Wind, mphr.					
Light, fc					
pH	7.30	7.75	7.70	7.4	7.25
D.O. ppm	Nil	Nil	Nil		Nil
Temperature °C	Varied 18 - 21	Varied 17 - 20	Varied 17 - 21	Varied 3 - 4	
Alkalinity, ppm CaCO	253	271	279	280	350
Color, T.C.U.				500	200
B.O.D., ppm	129	122	154	266	115
Nitrogen ppm — Total	21	22	19	33	33.0
Nitrogen ppm — Inorganic					
Total Solids ppm — Total	492	500	517	605	573
Total Solids ppm — Volatile	190	210	223	252	209
Suspended Solids, ppm — Total	56	72	84	72	108
Suspended Solids, ppm — Volatile	42	72	64	58	58
Chlorides, ppm					
Sulphates, ppm					
Phosphates, ppm					
Dissolved O2					
Sampling Interval - Hrs.	2	2	2	2	6
Inlet, feet					
Depth, feet					
Overflow	Yes	Yes	Yes	Yes	Yes

Table 9F

SEWAGE POND STUDY

Location Red Deer Pond #5 Sampling Point Outfall

Date		Nov. 15/61	Dec. 13	Jan. 10/62	FEb. 7	March 8	April 4	May 2	July 26/62
Time			12:20p.m.	1:40p.m.	12:45p.m.	11:15a.m.	1:10p.m.	2:00p.m.	2:00 PM
Wind, mphr.			Calm	Calm	10	5	20	20	Calm
Light, fc.			800	1000+	1000 +	1000+	1000+	1000+	Sunny
pH		6.9	7.0	6.8	6.8	6.7	7.2	7.0	7.4
D.O. ppm			0.6	0.7	NIL	NIL	NIL	NIL	NIL
Temperature °C.			3.0	1.0	0.2	0.5	6.0	10.0	21
Alkalinity, ppm	pp		--	--	--	--	--	--	--
	MO	238	250	225	225	210	260	300	300
Odor, T.O.N.			1000	40	400	6000	100	100	--
B.O.D., ppm		210	78	138	155	204	152	228	124
Nitrogens, ppm	Total		39.2	37.5	--	40.3	38.0	38.0	
	Ammonia	37.5	38.5	35.5	43.0	38.0	38.0	20.5	20
	Nitrite		0.008	NIL	0.004	NIL	0.010	0.001	
	Nitrate		0.050	0.163	0.290	0.362	0.300	0.070	
Total Solids ppm	Total	558	586	609	536	524	567	691	544
	Volatile	216	207	292	194	196	235	279	210
Suspended Solids, ppm	Total	37	24	25	32	91	46	36	40
	Volatile	37	24	25	32	85	41	36	40
Chlorides ppm			56	40	116	54	56	49	
Sulfates ppm				92	70	95	45	54	
Phosphates ppm			36	35	40	32	25	29	
Detergents ppm			8.1	9.0	6.8	7.5	6.6	6.6	
Ice, feet			--	0.3	0.3	--	--	--	--
Liquid, feet			--	5.0	5.0	5.0	5.0	5.0	
Ove flow				Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Red Deer Pond #5 Sampling Point Outfall

Date	Sept. 6	Nov. 14	Dec. 12/62	Jan. 16/63	Feb. 13	Mar. 20/63	April 17	Sept. 11
Time	12:30 pm	1:55 pm	1:15 pm	1:50 PM	3:55p.m.	1:10p.m.	3:10p.m.	2:00p.m.
Wind, mphr.	Calm	Calm	Calm	5	Calm	10	10	Calm
Light, fo.	900	350	1000+	500	500	1000+	1000+	800
pH	7.10	7.1	6.95	7.0	7.1	7.1	7.4	7.25
D.O. ppm	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C	17	5	3	2	3	7	9	17
Alkalinity, ppm pp MO	--	--	--	--	--	--	--	--
	265	350	325	300	260	265	290	335
Odor, T.O.N	20	50	200	500	800	500	800	500
B.O.D., ppm	123	187	263	269	263	245	205	93
Nitrogens, ppm — Ammonia	33	36	31.5	31	35	28.5	32.0	24
Nitrogens, ppm — Nitrite								
Nitrogens, ppm — Nitrate								
Total Solids ppm — Total	465	578	631	608	592	583	455	555
Total Solids ppm — Volatile	135	235	276	249	203	223	187	175
Suspended Solids, ppm — Total	49	72	61	56	38	36	110	130
Suspended Solids, ppm — Volatile	49	54	54	54	36	34	106	110
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet	--	--	½'	1.0		--	--	--
Liquid, feet								
Overflow	Yes	Yes	Yes	Yes	Yes	Yes	Yes	YEs

SEWAGE POND STUDY

Location Red Deer Pond #5 Sampling Point Outfall

Date		Jan. 8/64	Jan. 29	April 8/64
Time		12:45 pm	2:00p.m.	1:25 pm
Wind, mphr.		Calm	Calm	Calm
Light, fc.		1000+	1000+	1000+
pH		7.10	6.90	7.05
D.O. ppm		NIL	NIL	NIL
Temperature °C		3	5	9
Alkalinity, ppm	pp	--	--	--
	MO	350	330	310
Odor T.O.N.		200	300	100
B.O.D., ppm		127	130	122
Nitrogens, ppm	Total Ammonia	38.5	38.5	31.3
	Nitrate			
	Nitrite			
Total Solids ppm	Total	532	577	519
	Volatile	179	221	173
Suspended Solids, ppm	Total	48	58	43
	Volatile	48	58	32
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		0.5	0.3	--
Liquid, feet				
Overflow		Yes	Yes	Yes

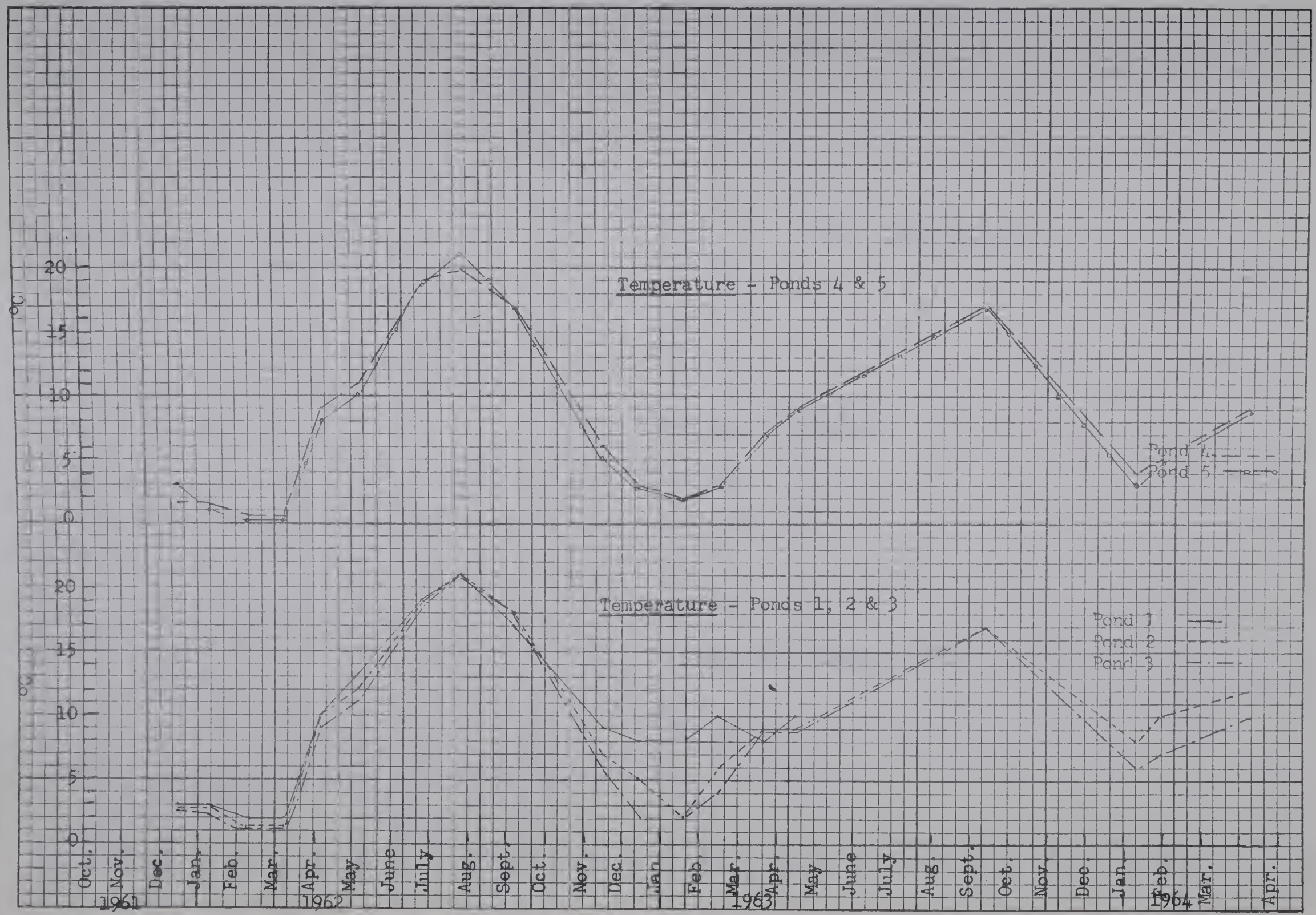
Table 9F

SEWAGE POND STUDY

Location: Red Deer Pond No. 5 — Sampling Point: Composite Samples

		June 1962					
Date		26-27	27-28	28-29	Feb. 20/63	Oct.9-10/63	Nov. 25-26/63
Time		10 Hrs.	24 Hrs	24 Hrs	7:00 am - 11:00 pm		9:00 am - 8:00 am
Wind, mphr.							
Light, fo.							
pH		7.8	7.7	7.4	7.4	7.25	7.2
D.O. ppm		Nil	Nil	Nil			
Temperature C		Varied 18 - 21	Varied 18 - 20	Varied 18 - 21	Varied 3 - 3.5		
Alkalinity ppm MO	pp	275	270	261	290	380	350
Odor, T.O.N					500	200	
B.O.D., ppm		100	78	118	227	87	163
Nitrogens, ppm	Total Ammonia	20	20	17	35	32.0	38.0
	Nitrite						
	Nitrate						
Total Solids ppm	Total	484	497	506	581	566	616
	Volatile	185	197	303	228	217	236
Suspended Solids, ppm	Total	68	86	72	100	66	98
	Volatile	68	84	58	91	34	72
Chlorides ppm							60
Sulfates ppm							
Phosphates ppm							
Detergents ppm							
Sampling Interval - Hrs.		2	2	2	2	6	3
Top, feet							
Liquid, feet							
Overflow		Yes	Yes	Yes	Yes	Yes	Yes

Sampled by
R.H.F. & L.C.



Red Deer

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Odor - Ponds 4 & 5

Pond 4 ——— Pond 5 ——o——o——

T.O.N. 5000 200 0

Odor - Ponds 1, 2 & 3

Pond 1 ——— Pond 2 - - - - - - Pond 3 — - — - —

T.O.N. 7000 5000 3000 1000 0

Alkalinity - Ponds 4 & 5

PPM as $CaCO_3$ 350 300 250 200

Alkalinity - Ponds 1, 2 & 3

PPM as $CaCO_3$ 350 300 250 200

Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

Ammonia - Nitrogen - Ponds 4 & 5

PPM

40
35
30
25
20
15

Pond 4
Pond 5

Ammonia - Nitrogen - Ponds 1, 2 & 3

PPM

45
40
35
30
25
20

Pond 1
Pond 2
Pond 3

Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

Red Deer

Total Solids - Ponds 4 & 5

Pond 4
Pond 5

PPM

650
600
550
500
450

Total Solids - Ponds 1, 2 & 3

800
750
700
650
600
550
500
450

Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
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Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.

1962
1963
1964

Red Deer

Suspended Solids

Ponds 4 & 5

Pond 4 — — —
Pond 5 ——o——o——

PPM

150
100
50
200

Suspended Solids

Ponds 1, 2 & 3

PPM

150
100
50

Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

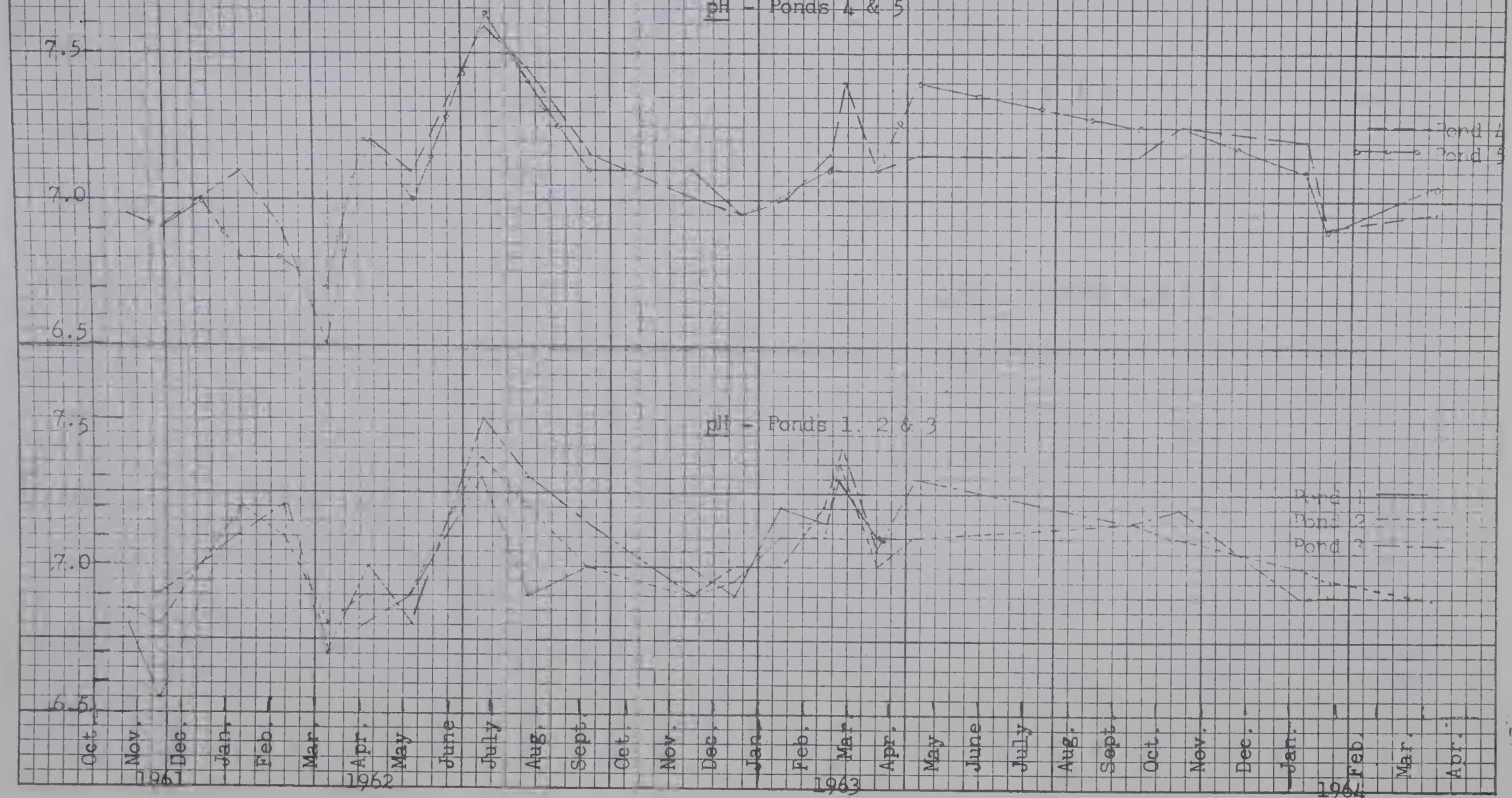
1961 1962 1963 1964

Pond 1
Pond 2
Pond 3

Red Deer

A-25

pH - Ponds 4 & 5



pH - Ponds 1, 2 & 3

Red Deer

B.O.D. - Ponds 4 & 5

Pond 4 ----
Pond 5 ---o---o---

PPM

300
250
200
150
100
50

Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.

1961 1962 1963 1964

B.O.D. - Ponds 1, 2 & 3

PPM

400
350
300
250
200
150
100

Pond 1
Pond 2
Pond 3

Red Deer

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STETTLER

Another of the combination of short and long detention ponds this system went into operation in the summer of 1960. The system consists of four short detention and two long detention ponds. However, during the sampling period of May 31, 1961 to February 4, 1964 two short detention ponds in addition to the long detention ponds were in use. The flow pattern during this period was short detention 1 to 2 to long detention 1 to 2. The long detention ponds are drained in the spring and fall, and are used for storage during the summer and winter. The system serves a population of 3,808 and a dairy which produces about 1,200 lb./day of butter and 3,500 qts./day of milk.

From B.O.D. analysis the winter efficiency of the short detention ponds was 37.3 percent and for the summer 62.6 percent. With the long detention ponds the overall efficiency for the entire system was 73.0% reduction in B.O.D. during the winter and a remarkable 95.5% in the summer. However, the additional treatment provided by the long detention ponds was approximately the same for both summer and winter.

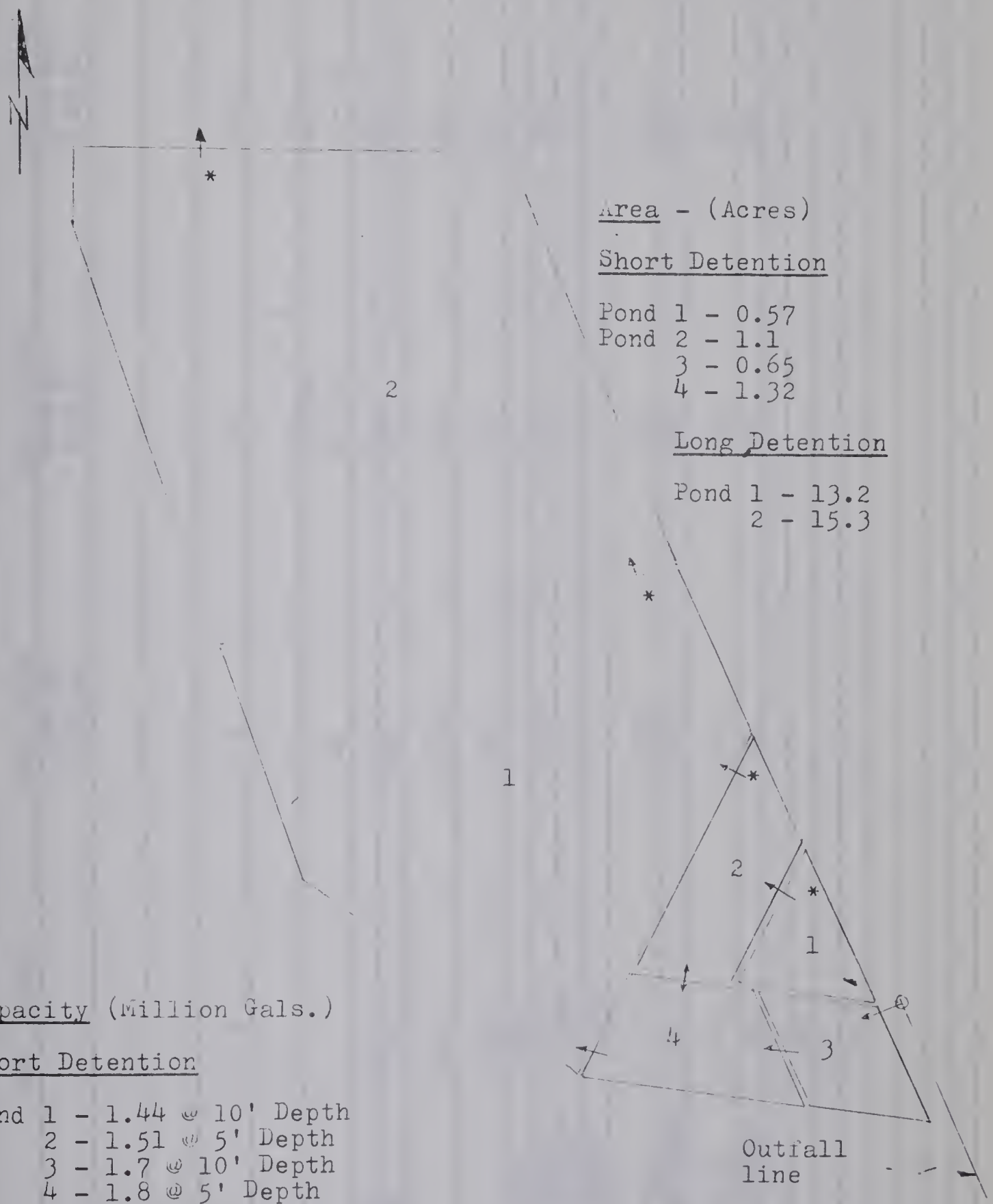
The pH of the short detention ponds were in a narrow range of 7.2 to 8.0 throughtout the year. However, in the long detention ponds the pH had a much wider range, 6.9 to 9.2, with the maximum readings occurring during the summer.

The ammonia-nitrogen had a larger degree of variation in the long detention ponds than in the short detention cells for the different seasons of the year. However, in both types of ponds the maximas were in the winter and the minimum readings in the summer. Total solids also showed similar trends.

Suspended solids in the short detention ponds reached their peaks during the winter months. In the long detention ponds the maximum values generally were either in the summer or early fall.

Generally odors near the long detention ponds were nil throughout the year. However, the liquid had some high T.O.N. values during the winter months. Odors of moderate concentration were detectable in the vicinity of the short ponds during the open water months. Only a thin ice cover, less than two inches, was observed on the first short detention cell throughout the winter while the other three ponds had ice thickness ranging from a few inches to three and a half feet.

PLAN OF STETTLER SEWAGE PONDS



Area - (Acres)

Short Detention

Pond 1 - 0.57
Pond 2 - 1.1
Pond 3 - 0.65
Pond 4 - 1.32

Long Detention

Pond 1 - 13.2
Pond 2 - 15.3

Capacity (Million Gals.)

Short Detention

Pond 1 - 1.44 @ 10' Depth
Pond 2 - 1.51 @ 5' Depth
Pond 3 - 1.7 @ 10' Depth
Pond 4 - 1.8 @ 5' Depth

Long Detention

Pond 1 - 17.9 @ 5' Depth
Pond 2 - 20.8 @ 5' Depth

Scale 1" = 300'
* - Sampling points

Figure 17

Table 10A

SEWAGE POND STUDY

Location: Stettler Raw Sewage — Sampling Point:

Date		Jan. 31/62	April 28/64	April 29/64	April 30/64
Time			1:00 pm 8:00 pm	8:00 am 8:00 pm	8:00 am 8:00 pm
Wind, mphr.					
Light, fo.					
pH		7.9	7.8	7.8	8.15
D.O. ppm					
Temperature °C.			10	varied 8 - 11	varied 9 - 10
Alkalinity, ppm	pp	-	-	-	-
	MO	825	871	875	925
Odor, T.O.N.		250	300	500	200
B.O.D., ppm		235	385	240	385
Nitrogens, ppm	Total	60.2			
	Ammonia	41.0	47.5	46.5	56.5
	Nitrite	0.062			
	Nitrate	0.450			
Total Solids ppm	Total	1657	1596	1644	1651
	Volatile	454	398	464	464
Suspended Solids, ppm	Total	195	264	260	332
	Volatile	150	184	204	308
Chlorides ppm		56			
Sulfates ppm		250			
Phosphates ppm		53			
Detergents ppm		14.7			
Ice, feet					
Liquid, feet					
Overflow					

Table 10B

SEWAGE POND STUDY

Location Stettler Short 1 Sampling Point Outfall of Short 1

Date		May 31/61	June 21	Dec. 6/61	Jan.3/62	Jan. 31	March 1	March 28	April 25
Time		12^{00}a.m.	1^{05}p.m.	9^{25}a.m.	9^{30}a.m.	9^{10}a.m.	2^{05}a.m.	8^{45} a.m.	9^{15}a.m.
Wind, mphr.		15m.p.h.	25	Calm	Rain Calm	10	Calm -30°F	Calm	Calm
Light, fo.		1000 +	1000 +	350	500	280	1000+	1000 +	1000+
pH		7.4	7.5	7.4	7.4	7.3	7.5	7.4	7.4
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		20	16	3.0	3.0	1.5	1.5	4.0	10.0
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	840	880	900	775	790	885	710	820
Odor, T.O.N.		1500	1250	10000	3000	3000	3000	800	400
B.O.D., ppm		225	309	301	115	190	218	188	201
Nitrogens, ppm	Total	65.8	--	72.0	67.2	51.5	71.0	47.1	58.2
	Ammonia	75	101	55.5	66.0	44.0	74.0	44.0	27.0
	Nitrite	0.004	--	0.007	NIL	0.030	0.015	0.010	0.015
	Nitrate	3.48	--	0.05	0.110	0.312	0.200	0.100	0.000
Total Solids ppm	Total	1495		1373	1413	1356	1462	1210	1362
	Volatile	335		231	467	280	232	208	231
Suspended Solids, ppm	Total	66		66	55	96	154	38	70
	Volatile	54		66	41.0	94	88	30	70
Chlorides ppm		130		20	54	34	56	42	44
Sulfates ppm		590		255	220	225	212	209	204
Phosphates ppm		6.0	1.0	52.5	42.0	47	48	34	53
Detergents ppm		9.32		6.0	10.0	1o.2	1.20	10.0	12.0
		--							
Ice, feet		--		--	--	--	0.2	--	--
Liquid, feet		--		--	--	--	2.0	--	--
Overflow		--		YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Stettler Short 1 Sampling Point Outfall of Short 1

Date		July 19/62	Aug. 23	Nov. 7	Dec. 5	Jan. 8/63	Feb. 6	Mar. 13	April 10
Time		11:00 am	10:20 am	3:05 pm	11:30 am	12:15	8:25 am	noon 12:00	10:30 am
Wind, mphr.		Calm	Calm	10	Calm	Calm	5	Calm	10
Light, fo.		Sunny	1200	1000	800	1000+	300	1000+	1000+
pH		7.45	7.40	7.65	7.8	7.6	7.7	7.8	7.75
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		18	15	7	5	3.0	2	5	9
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	940	980	920	935	870	750	715	830
Odor, T.O.N.		-	500	1200	4000	3000	4000	1000	1500
B.O.D., ppm		181	185	226	241	286	225	173	250
Nitrogens, ppm	Total Ammonia	51.5	48.6	44.5	50.5	50	42.8	38.8	47
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1425	1446	1313	1392	1400	1216	1288	1335
	Volatile	297	265	173	256	273	194	254	239
Suspended Solids, ppm	Total	80	82	52	72	118	62	142	70
	Volatile	63	71	34	62	112	50	88	54
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Color									Green
Ice, feet		-	-	-	1"	-	0.3	-	-
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location: Stettler Short 1 — Sampling Point: Outfall of Short 1

		July 18/63	Dec. 4	Feb. 4/64
Date				
Time		3:30 pm	12:20 pm	12:05 pm
Wind, mphr.		Calm	Calm	5
Light, fo.		1000+	1000+	1000+
pH		7.45	7.45	7.6
D.O. ppm		Nil	Nil	Nil
Temperature °C.		22	5	4
Alkalinity, ppm	pp	-	-	-
	MO	715	910	955
Odor, T.O.N.		2000	1500	2000
B.O.D., ppm		108	248	263
Nitrogens, ppm	Total Ammonia	25	45	52
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1218	1471	1439
	Volatile	181	293	429
Suspended Solids, ppm	Total	92	118	110
	Volatile	80	116	94
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Color		Green		
Ice, feet		-	-	-
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 10C

SEWAGE POND STUDY

Location Stettler Short Pond 2 Sampling Point Outfall of Short 2

Date		May 31/61	June 21	Dec. 6	Jan.3/62	Jan. 31	March 1	March 28	April 25
Time		12:10 pm	1:10 pm	9:35 am	9:15 am	9:00 am	1:55 pm	8:30 am	9:00 am
Wind, mphr.		15	25	Calm	Calm	10	Calm	Calm	Calm
Light, fo.		1000	1000+	390	480	280	1000+	1000+	1000+
pH		7.65	8.25	7.6	7.4	7.3	7.4	7.5	7.5
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		21	17	1.5	1.5	0.5	0.5	1.5	10.0
Alkalinity, ppm	pp	-	-	--	-	-	-	-	-
	MO	850	995	925	790	825	940	750	775
Odor, T.O.N.		750	500	10000	3000	5000	3000	1200	200
B.O.D., ppm		155	156	223	105	166	223	188	180
Nitrogens, ppm	Total	61.8	-	67.0	66.2	53.2	75.0	67.1	47.6
	Ammonia	66.0	67	60.0	46.0	48.5	69.0	45.0	25.0
	Nitrite	0.006		0.001	Nil	0.025	0.015	0.010	0.020
	Nitrate	3.48		0.02	Nil	0.405	0.162	0.095	0.000
Total Solids ppm	Total	1509		1404	1318	1327	1462	1249	1221
	Volatile	319		231	221	234	232	225	206
Suspended Solids, ppm	Total	62		62	38	49	132	37	29
	Volatile	58		60	27	49	101	27	29
Chlorides ppm		130		25	50	32	62	46	44
Sulfates ppm		535		208	218	230	222	222	204
Phosphates ppm		6.3	2.5	51.3	44.0	54	51	35	44
Detergents ppm		8.4		6.0	12.4	10.3	11.2	11.5	11.3
Ice, feet		-		-	-	-	0.3	-	-
Liquid, feet		-		-	-	-	2.0	-	-
Overflow		-		Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Stettler Short Pond 2 Sampling Point Outfall of Short 2

Date		July 19/62	Aug. 23	Nov. 7	Dec. 5	Jan. 8/63	Feb. 6	Mar. 13	April 10
Time		11:00 am	10:30 am	3:10 pm	11:40 am	noon 12:00	8:40 am	12:10 pm	10:35 am
Wind, mphr.		Calm	Calm	10	Calm	Calm	5	Calm	10
Light, fo.		Sunny	1200	1000	800	1000+	300	1000+	1000+
pH		8.05	7.75	7.8	7.7	7.5	7.75	7.7	7.70
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		19	15	5	5	1.5	2	3	6
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	990	1030	965	940	905	805	685	790
Odor, T.O.N.			200	800	2000	1500	3000	2000	1500
B.O.D., ppm		133	114	181	231	186	229	170	212
Nitrogens, ppm	Total Ammonia	52.5	50.5	37.5	51.5	47	47.8	40.5	44.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1379	1626	1359	1399	1361	1325	1244	1261
	Volatile	277	277	234	260	239	233	246	220
Suspended Solids, ppm	Total	72	115	23	30	100	42	158	64
	Volatile	70	115	20	27	92	37	110	52
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		-	-		½'	0.7	0.5	1'	-
Liquid, feet									
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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SEWAGE POND STUDY

Location: Stettler Short Pond 2 — Sampling Point: Outfall of Short 2

Date		July 18/63	Dec. 4	Feb. 4/64
Time		3:35 pm	12:30 pm	11:50 am
Wind, mphr.		Calm	Calm	5
Light, fo.		1000+	1000+	1000+
pH		7.90	7.50	7.6
D.O. ppm		Nil	Nil	Nil
Temperature °C.		22	2	2
Alkalinity, ppm	pp	-	-	-
	MO	710	960	950
Odor, T.O.N.		1000	1000	600
B.O.D., ppm		49	198	223
Nitrogens, ppm	Total			
	Ammonia	21	45.8	51
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1150	1381	1385
	Volatile	136	220	369
Suspended Solids, ppm	Total	56	28	72
	Volatile	46	26	70
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		-	0.2	0.2
Liquid, feet				
Overflow		Yes	Yes	Yes

Table 10D

SEWAGE POND STUDY

Location Stettler Long Detention 1 Sampling Point Outfall of Long Detention #1

Date		May 31/61	June 21	Dec. 6	Jan. 3/62	Jan. 31	March 1	March 28	April 25
Time		12:20 pm	1:40 pm	10:00 am	10:00 am	8:45 am	1:40 pm	8:20 am	8:50 am
Wind, mphr.		15	25	Calm	Calm	10	Calm	Calm	Calm
Light, fo.		1000	1000+	350	480	280	1000+	1000+	1000+
pH		8.2	8.0	8.2	7.9	7.5	7.5	7.6	6.8
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		18	19	0.5	1.0	0.2	0.2	0.7	6.0
Alkalinity, ppm	pp			-	-	-	-	-	-
	MO	950	965	1160	1405	1220	1300	840	340
Odor, T.O.N.		60	80	8000	4000	2000	4000	3000	800
B.O.D., ppm		17	36	99	79	189	201	152	73
Nitrogens, ppm	Total	58.8		47.0	44.2	57.8	81.2	78.2	18.8
	Ammonia	43.0	29	40.0	41.0	55.5	72.0	45.0	10.5
	Nitrite	0.01		0.001	Nil	0.010	0.010	0.013	0.015
	Nitrate	3.74		0.02	0.08	0.325	0.200	0.095	0.000
Total Solids ppm	Total	1466		1727	2027	1772	1980	1243	530
	Volatile	387		186	228	253	304	232	72
Suspended Solids, ppm	Total	50		36	21	51	69	27	25
	Volatile	38		32	13	44	52	27	25
Chlorides ppm		125		73	72	30	56	49	12
Sulfates ppm		450		165	230	203	231	226	70
Phosphates ppm		6.0	5.2	67.5	43.7	65	66	45	19
Detergents ppm		7.0		6.4	14.0	12.2	15.1	10.6	8.5
Ice, feet		-		1.0	1.0	3.0	3.5	3.0	-
Liquid, feet		-		4.0	3.0	2.5	2.0	3.0	2.0
Overflow		-		Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Stettler Long Detention 1 Sampling Point Outfall of Long Detention 1

Date		July 19/62	Aug. 23	Nov. 7	Dec. 5	Jan 8/63	Feb. 6	Mar. 13	July 18
Time		11:20 am	11:00 am	3:20 pm	12:00 pm	12:30 pm	9:00 am	12:30 pm	3:45 pm
Wind, mphr.		Calm	Calm	10	Calm	Calm	5	Calm	Calm
Light, fo.		Sunny	1200+	1000	800	1000+	300	1000+	1000+
pH		8.50	8.75	8.5	8.1	7.8	7.9	7.75	9.45
D.O. ppm		7.0	14.0	5.8	Nil	Nil	Nil	Nil	33.2
Temperature °C.		18	18	5	3	1.0	1	2	22
Alkalinity, ppm	pp	75	40	30	-	-	-	-	115
	MO	715	835	870	1095	1205	1340	950	510
Odor, T.O.N.		-	2	20	500	1500	2000	2000	100
B.O.D., ppm		12	22	47	73	124	200	150	19
Nitrogens, ppm	Total Ammonia	20.5	16	14	38	48.5	63	46.5	4.3
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1154	1303	1423	1522	1679	851	1448	1071
	Volatile	178	191	237	195	226	227	202	144
Suspended Solids, ppm	Total	41	77	124	47	50	30	60	102
	Volatile	38	72	121	45	48	26	52	84
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		-	-	-	1.0	1.0	2.0	3.0	-
Liquid, feet		2.0				2.5	3.0	2.0	
Overflow		Yes	Yes	No	?	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location: Stettler Long Dentention 1 — Sampling Point: Outfall of Long Detention 1

Date		Dec. 4/63	Feb. 4/64
Time		12:10 pm	11:30 am
Wind, mphr.		Calm	5
Light, fo.		1000+	1000+
pH		7.5	8.0
D.O. ppm		Nil	Nil
Temperature °C.		1	1
Alkalinity, ppm	pp	-	-
	MO	1090	1350
Odor, T.O.N.		500	600
B.O.D., ppm		167	231
Nitrogens, ppm	Total Ammonia	48	64.5
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1620	1796
	Volatile	232	281
Suspended Solids, ppm	Total	26	68
	Volatile	24	64
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		0.5	2.5
Liquid, feet		1.0	
Overflow		No	Yes

Table 10E

SEWAGE POND STUDY

Location Stettler Long Detention 2 Sampling Point Outfall of Long Detention 2

Date		May 18/61	May 31	June 21	Dec. 6	Jan. 3/62	Jan. 31	*Mar. 1	Mar. 28
Time		11:20 am	12:30 pm	2:00 pm	10:30 am	10:30 am	9:20 am	2:40 pm	9:20 am
Wind, mphr.		-	15	25	Calm	Calm	Calm	5	Calm
Light, fo.		1000	1000	1000+	420	460	270	1000+	1000+
pH		7.9	8.15	8.2	8.2	8.0	7.6	7.3	7.5
D.O. ppm		Nil	0.15	0.7	0.2	Nil	Nil	Nil	Nil
Temperature °C.		14	18	20	0.5	1.0	0.1	0.1	0.5
Alkalinity, ppm	pp		-		-	-	--	-	-
	MO	840	870	930	1395	1625	1500	1865	1020
Odor, T.O.N.		400	30	50	400	10	6000	6000	5000
B.O.D., ppm		84	27.0	36	19	27	162	229	187
Nitrogens, ppm	Total	29.2	50.4		25.5	37.4	57.8	94.2	59.0
	Ammonia	22.1	37.3	19.0	18.5	36.5	58.5	92.0	54.5
	Nitrite	0.006	0.009		0.003	Nil	0.022	0.010	Nil
	Nitrate	0.17	3.74		0.51	0.14	0.357	0.262	0.095
Total Solids ppm	Total	1294	1395		1066	1319	2161	2583	1363
	Volatile	134	186		180	200	271	340	184
Suspended Solids, ppm	Total	48	38		56	27	35	67	14
	Volatile	42	34		52	13	35	55	14
Chlorides ppm		50	145		80	88	44	86	45
Sulfates ppm		187	565		240	255	230	240	171
Phosphates ppm		43.5	2.2	Nil	74	43	94	85	54
Detergents ppm		6.7	7.3		5.3	14.4	12.3	18.7	13.2
Oils and greases		1.3	-						
Ice, feet		-	-		1.5	1.5	3.5	0.5	0.3
Liquid, feet		-	-		4.0	2.0	2.0	1.0	1.0
Overflow		-	-		No 8	Yes	No	No	No

*Pond #2 long drawn off from Jan. 31 to March 1/63
Melting around edges March 28

SEWAGE POND STUDY

Location Stettler Long Detention 2 Sampling Point Outfall of Long Detention 2

Date		July 19	Aug. 23	Nov. 7	Dec. 5	Jan. 8/63	Feb. 6	Mar. 13
Time		11:30 am	11:30 am	3:30 pm	12:20 pm	11:50am	9:30 am	12:45 pm
Wind, mphr.		Calm	Calm	10	Calm	Calm	5	Calm
Light, fo.		sunny	1000	1000	800	1000+	300	1000+
pH		8.35	8.30	9.0	8.95	8.55	8.05	7.80
D.O. ppm		1.6	1.8	10.0	13	3.8	Nil	Nil
Temperature °C.		19	17	5	4	0.5	1	1
Alkalinity, ppm	pp	-		100	135	85	-	-
	MO	735	845	760	990	1590	1425	1020
Odor, T.O.N.		-	2	4	20	10 musty	1000	500
B.O.D., ppm		13	3.0	30	6	7	107	162
Nitrogens, ppm	Total Ammonia	8	14.5	13	4.5	5.2	63	52
	Nitrite							
	Nitrate							
Total Solids ppm	Total	1307	1288	1438	1684	2520	954	1490
	Volatile	250	129	184	157	185	226	209
Suspended Solids, ppm	Total	52	23	110	23	34	28	38
	Volatile	32	22	22	17	30	21	38
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet		-	-	-	1.0	1.0	2.5	3.0
Liquid, feet		2.0				2.0	1.5	1¾
Overflow		No	No	No	No	No	No	No

SEWAGE POND STUDY

Location Stettler Long Detention 2 Sampling Point Outfall of Long Detention 2

Date		July 18/63	Dec. 4	Feb. 4/64
Time		4:00 pm	11:55 pm	12:15 pm
Wind, mphr.		Calm	Calm	5
Light, fo.		1000+	1000+	1000+
pH		8.3	7.5	8.0
D.O. ppm		3.0	0.8	Nil
Temperature °C.		22	1	1
Alkalinity, ppm	pp	-	-	-
	MO	530	1935	2000
Odor, T.O.N.		10	10	1000
B.O.D., ppm		4	14	Septic
Nitrogens, ppm	Total Ammonia	10.4	20.3	75
	Nitrite			
	Nitrate			
Total Solids ppm	Total	844	2901	3332
	Volatile	98	264	431
Suspended Solids, ppm	Total	23	60	60
	Volatile	21	38	56
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		-	0.5	2.5
Liquid, feet			1.5'	1'
Overflow		No	No	No

Suspended Solids
Long Detention Ponds

ppm
100
50
20

Pond
Pond

Suspended Solids
Short Detention Ponds

ppm
150
100
50

Pond
Pond

Total Solids - Long Detention Ponds

ppm
3000
2500
2000
1500
1000
500

Po
Po

Total Solids - Short Detention Ponds

ppm
1500
1000

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1962 1963 1964

STETTIER

Temperature
Short Detention Ponds

°C

20
15
10
5

Pond 1
Pond 2

Dissolved Oxygen - Long Detention Ponds

ppm

30
20
10

Pond 1
Pond 2

pH - Long Detention Ponds

9
8
7

pH - Short Detention Ponds

8
7

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1962 1963 1964

STETTLER

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Ammonia-Nitrogen Long Detention Ponds

ppm

90
80
70
60
50
40
30
20
10

—— Pond 1
- - - Pond 2

Ammonia - Nitrogen Short Detention Ponds

ppm

70
60
50
40
30
20

—— Pond 1
- - - Pond 2

B.O.D. - Long Detention Ponds

ppm

200
100
0

—— Pond 1
- - - Pond 2

B.O.D. - Short Detention Ponds

ppm

300
200
100
0

—— Pond 1
- - - Pond 2

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1962 1963 1964

STETTLER

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Odor - Long Detention Ponds

T.O.N.

5000

1000

10000

Pond 1
Pond 2

Oder - Short Detention Ponds

T.O.N.

5000

Pond 1
Pond 2

Alkalinity - Long Detention Ponds

2000

1500

1000

500

ppm

Pond 1
Pond 2

Alkalinity - Short Detention Ponds

1100

500

ppm

Pond 1
Pond 2

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

1962 1963 1964

STETTLER

Figure 18

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STONY PLAIN

The Stony Plain sewage system, consisting of three short detention cells and one long detention ponds, serves a population of 1,463 and the normal commercial establishments. This system was studied in 1958 and 1959 and the results were reported in a Sanitary Engineering publication in 1961. The three short detention cells are operated with continuous overflows while the long detention pond is used primarily for storage. During a short period in the summer of 1963 the short detention ponds were bypassed while the first cell was cleaned out.

The overall efficiency of the short detention cells was 66.1% B.O.D. reduction in the winter as compared to a summer performance of 73.6%. The addition of the long detention pond has provided a high degree of treatment 94.2% B.O.D. reduction, during the summer. However, in the winter the long detention pond only provided an additional B.O.D. removal of 3.9%. Dissolved oxygen was present in the long detention pond from an early April to the end of November.

There was a slight variation in the pH of the three short detention cells; increasing in the fall and early winter, and decreasing in the spring and summer. However, in the long detention pond the pH fluctuated in a range of 7.1 to 9.4 with the maximum readings in summer and the minimum readings in the winter.

In the short detention ponds, there was no decrease in the ammonia-nitrogen content with detention time during the winter and fall. No definite trends in the concentration was established for each pond. During the summer there was a significant difference in the ammonia-nitrogen concentrations between the short detention cells and the long detention pond.

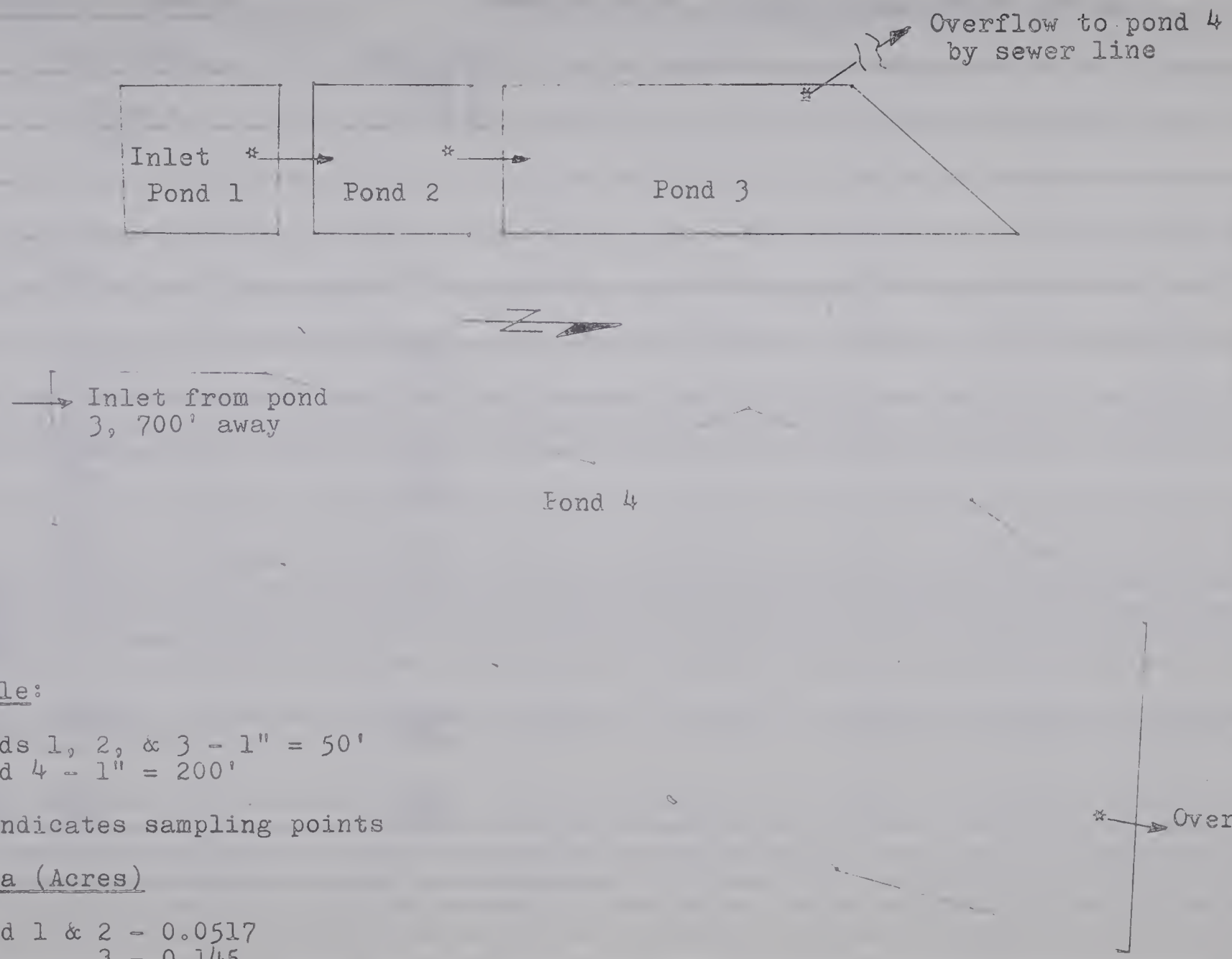
Alkalinity reached their maximum values during the winter and minimum readings in the summer.

Generally suspended solids showed a decrease with detention time in the entire system. Suspended solids in the first short detention cell varied from 45 ppm to 372 ppm while the remainder of the system had a range from 5 ppm to 125 ppm.

Total solids in the short detention ponds fluctuated throughout the year with no definite seasonal trends being established. However, the total solid content did decrease with detention time. In the long detention cell total solids reached their peaks during the winter and minimas in the summer or spring.

Odors in the immediate area of the ponds were of very low concentration throughout the year.

In the first and second short detention ponds ice cover ranged from nil to about two inches during the winter. The third short detention pond had a maximum ice thickness of about one foot.



Plan of Stony Plain Sewage Ponds

Figure 19

Scale:

Ponds 1, 2, & 3 - 1" = 50'
Pond 4 - 1" = 200'

* Indicates sampling points

Area (Acres)

Pond 1 & 2 - 0.0517
3 - 0.145
4 - 9

Capacity (Million Gals.)

Pond 1 & 2 - 0.0703 @ 6 ft. Depth
3 - 0.1976 @ 6 ft. Depth
Pond 4 - 14.19 @ 4 ft. Depth

Table 11A

SEWAGE POND STUDY

Location: Stony Plain Raw Composite — Sampling Point: Last Manhole Before Pond No. 1

Date		Apr. 15/64	June 10/64
Time		7:30 am - 11 pm.	8:00 am - 8:00 pm
Wind, mphr.			
Light, fo.			
pH		8.3	7.7
D.O. ppm			
Temperature °C.		From 6 - 8	From 6 - 9
Alkalinity, ppm	pp	-	-
	MO	580	530
Odor, T.O.N.		200	1000
B.O.D., ppm		390	270
Nitrogens, ppm	Total Ammonia	59.5	72.0
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1746	1442
	Volatile	736	489
Suspended Solids, ppm	Total	398	348
	Volatile	304	228
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet			
Liquid, feet			
Overflow			

Table 11P

SEWAGE POND STUDY

Location: Stony Plain Pond #1 — Sampling Point: Outfall of Pond #1

Date		Dec. 20/61	Jan. 17/62	Feb. 14	March 14	April 11	June 12	July 11	Aug. 2
Time		1:25 pm	11:40 am	11:50 am	1:40 am	11:30 am	3:00 pm	12:20 pm	1:30 pm
Wind, mphr.		Calm	Calm	Calm	Calm	5	Calm	Calm	5
Light, fo.		840	1000+	800	1000+	1000+		cloudy	Hazy
pH		7.9	7.8	7.7	7.8	7.9	7.45	7.4	7.15
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		4.0	0.5	1.0	2.0	6.0	20	15	18
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	440	450	410	450	425	350	345	350
Odor, T.O.N.		2400	16	60	100	150	-	-	500
B.O.D., ppm		130	96	131	132	101	190	206	243
Nitrogens, ppm	Total	48.0	53.2	53.0	54.4	41.5			
	Ammonia	51.0	46.0	49.0	45.0	28.5	32.5	37.0	27.5
	Nitrite	0.025	0.001	Nil	0.020	0.020			
	Nitrate	0.225	0.922	Nil	0.205	0.075			
Total Solids ppm	Total	1034	1207	982	1164	1005	1093	1302	1209
	Volatile	304	464	295	338	298	345	406	374
Suspended Solids, ppm	Total	48	49	35	44	48	130	128	306
	Volatile	46	43	29	44	48	81	100	100
Chlorides ppm		98	88	88	102	68			
Sulfates ppm		245	258	205	268	210			
Phosphates ppm		35	33	17	40	21			
Detergents ppm		11.6	6.6	4.6	5.7	2.2			
Ice, feet		-	01	-	-	-	-	-	-
Liquid, feet		-	2.0	1.0	-	-	-	-	-
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Beginning this day samples taken from Manhole.

SEWAGE POND STUDY

Location Stony Plain Pond #1 Sampling Point Outfall of Pond #1

Date		Oct. 11/62	Nov. 21	Jan. 3/63	Jan. 23	Mar. 7	April 3	May 22 /63
Time		1:45 pm	12:40 pm	1:20 pm	1:00 pm	11:50 am	1:30 pm	
Wind, mphr.		10	5	Calm	Calm	15	Calm	
Light, fo.		1000+	1000+	1000+	500	1000+	1000+	
pH		7.35	7.8	8.2	7.9	7.9	7.6	
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	
Temperature °C.		12	4	4	0.5	5	9	
Alkalinity, ppm	pp	-	-	-	-	-	-	
	MO	425	405	500	475	445	405	
Odor, T.O.N.		1500	800	1000	2000	2000	1000	
B.O.D., ppm		254	191	196	237	175	187	
Nitrogens, ppm	Total Ammonia	42	38	36.5	37.5	48	35	
	Nitrite							
	Nitrate							
Total Solids ppm	Total	1311	1131	1238	1104	1246	1102	
	Volatile	407	320	357	369	429	353	
Suspended Solids, ppm	Total	254	160	144	180	158	200	
	Volatile	178	132	129	130	142	118	
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet		-	-	-	-	-	-	
Liquid, feet		-	-	-				
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	

BY - PASSED

SEWAGE POND STUDY

Location Stony Plain Pond #1 Sampling Point Outfall of Pond #1

Date		Jan. 22/64	April 15
Time		2:30 pm	3:30 pm
Wind, mphr.		Calm	Calm
Light, fo.		1000+	800
pH		7.8	7.7
D.O. ppm		Nil	Nil
Temperature °C.		3	7
Alkalinity, ppm	pp	-	-
	MO	505	570
Odor, T.O.N.		1500	800
B.O.D., ppm		255	307
Nitrogens, ppm	Total Ammonia	44	52.5
	Nitrite		
	Nitrate		
Total Solids ppm	Total	1352	1494
	Volatile	415	424
Suspended Solids, ppm	Total	372	200
	Volatile	192	172
Chlorides ppm			
Sulfates ppm			
Phosphates ppm			
Detergents ppm			
Ice, feet		-	-
Liquid, feet			
Overflow		Yes	Yes

Settleable solids
11.4 ml./l.

Table 11C

SEWAGE POND STUDY

Location Stony Plain Pond #2 — Sampling Point Outfall of Pond 2

Date		Dec. 20/61	Jan.17/62	Feb. 14	March 14	April 11	June 12/62	July 11/62	Aug.2
Time		1:35p.m.	11:50a.m.	12:00 p.m.	1:50 p.m.	12:00 p.m.	2:50 p.m.	12:30 p.m.	1:20 p.m.
Wind, mphr.		CALM	CALM	CALM	CALM	5	CALM	CALM	5
Light, fo.		840	1000+	800	1000+	1000+	Sunny	Cloudy	Hazy
pH		7.9	7.8	7.7	7.9	7.6	7.45	7.4	7.35
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		3.0	0.5	0.8	1.2	6.0	20	16	19
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	450	455	430	410	410	350	330	340
Odor, T.O.N.		2400	3000	400	600	300	--	--	100
B.O.D., ppm		118	81	97	133	73	122	125	111
Nitrogens, ppm	Total	44.8	49.3	49.0	46.0	43.5			
	Ammonia	20.5	42.5	40.0	44.0	12.0	29.0	13.0	24.5
	Nitrite	0.006	0.006	NIL	0.018	0.006			
	Nitrate	0.23	0.500	NIL	0.095	NIL			
Total Solids ppm	Total	1013	1028	911	965	1007	1041	938	894
	Volatile	270	285	157	272	286	309	260	257
Suspended Solids, ppm	Total	37	35	36	54	23	89	43	48
	Volatile	35	33	30	54	23	81	32	12
Chlorides ppm		100	88	62	84	60			
Sulfates ppm		230	265	200	270	212			
Phosphates ppm		33	38	33	26	15			
Detergents ppm		10.7	8.2	4.2	5.6	3.0			
Ice, feet		0.1	0.1	--	--	--	--	--	--
Liquid, feet		3.0	3.0	2.0					
Overflow		YES	YES	YES	YES	YES	YES	YES	YES

SEWAGE POND STUDY

Location Stony Plain Pond #2 Sampling Point Outfall of Pond 2

Date		Oct. 11	Nov. 21	Jan. 3/63	Jan.23/63	Mar. 7	April 3	Jan. 22/64	April 15
Time		1:40 p.m.	12:35 p.m.	1:15p.m.	1:10 p.m.	11:45 a.m.	1:40 p.m.	2:20 p.m.	3:40 pm
Wind, mphr.		10	5	CALM	CALM	15	CALM	CALM	CALM
Light, fo.		1000	1000	1000+	500	1000+	1000+	1000+	800
pH		7.35	7.8	8.1	7.9	7.85	7.8	7.65	7.6
D.O. ppm		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Temperature °C.		11	4	1	1.0	4	8	1	6
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	425	380	450	450	390	420	530	545
Odor, T.O.N.		1500	500	500	1000	1000	600	300	1000
B.O.D., ppm		163	144	113	143	88	140	177	237
Nitrogens, ppm	Total Ammonia	40	276	24	29.5	28	31	41.3	48.0
	Nitrite								
	Nitrate								
Total Solids ppm	Total	1085	941	1038	957	1041	954	1216	1270
	Volatile	308	163	270	287	318	293	342	344
Suspended Solids, ppm	Total	83	72	114	78	106	100	114	76
	Volatile	74	70	114	56	86	90	84	74
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		--	--	in spots	0.1	--	--	0.2	--
Liquid, feet									
Overflow		YES	YES	YES	YES	YES	YES	YES	YES

Table 11D

SEWAGE POND STUDY

Location Stony Plain Pond #3 Sampling Point Outfall of Pond #3

Date		Dec. 20/61	Jan. 17/62	Feb. 14	Mar. 14	April 11	June 12	July 11	Aug. 2/62
Time		1:50 pm	12:00 pm	12:15 pm	2:00 pm	12:10 pm	2:40 pm	12:35 pm	1:15 pm
Wind, mphr.		Calm	Calm	Calm	Calm	5	Calm	Calm	5
Light, fo.		840	1000+	900	1000+	1000+	sunny	Cloudy	Hazy
pH		7.0	7.5	7.5	7.7	7.4	7.50	7.35	7.3
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		1.0	0.5	0.2	0.8	5.0	20	15	19
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	370	450	450	460	445	350	350	375
Odor, T.O.N.		1000	2000	3000	2000	500	—	—	100
B.O.D., ppm		110	69	109	118	100	56	113	92
Nitrogens, ppm	Total	42.0	42.0	55.0	47.0	38.5			
	Ammonia	29.5	40.0	51.0	37.0	7.0	23.7	18.7	22.5
	Nitrite	0.010	0.005	Nil	0.016	0.005			
	Nitrate	0.580	0.685	Nil	0.043	0.075			
Total Solids ppm	Total	974	992	941	1013	1062	929	892	887
	Volatile	255	265	255	227	294	235	246	247
Suspended Solids, ppm	Total	36	49	31	34	10	26	26	30
	Volatile	34	42	31	34	10	23	24	20
Chlorides ppm		86	86	92	100	102			
Sulfates ppm		225	250	263	247	215			
Phosphates ppm		33	36	39	38	28			
Detergents ppm		11.6	6.6	8.7	5.3	4.4			
Ice, feet		0.1	0.25	0.2	-	-	-	-	-
Liquid, feet		1.0	4.0	3.0	2.0	2.0	-	-	-
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location Stony Plain Pond #3 Sampling Point Outfall of Pond #3

Date		Oct. 11/62	Nov. 21	Jan. 3/63	Jan. 23	Mar. 7	April 3	Jan. 22/64	April 15
Time		1:30 pm	12:30 pm	1:10 pm	1:20 pm	11:35 am	1:45 pm	2:15 pm	3:45 pm
Wind, mphr.		10	5	Calm	Calm	15	Calm	Calm	Calm
Light, fo.		1000	1000	1000+	500	1000+	1000+	1000+	800
pH		7.4	7.5	7.95	7.7	7.85	7.65	7.3	7.6
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		10	5	2	1.0	4	8	1	6
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	450	425	500	520	435	400	525	565
Odor, T.O.N.		1000	1000	500	800	500	200	800	500
B.O.D., ppm		130	128	107	132	94	102	155	186
Nitrogens, ppm	Total Ammonia	50	30	33.5	29.5	29.5	27.5	40.5	45.8
	Nitrite								
	Nitrate								
Total Solids ppm	Total	989	918	965	1008	992	887	1124	1239
	Volatile	274	260	240	279	271	254	-	332
Suspended Solids, ppm	Total	40	36	54	54	64	45	66	37
	Volatile	38	34	48	38	64	44	54	36
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		-	0.1	0.3	1.0	-	-	0.2	-
Liquid, feet		-							
Overflow		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11E

SEWAGE POND STUDY

Location Stony Plain Pond 4 — Sampling Point Outfall of #4

Date		May 10/61	Nov. 22	Dec. 20/61	Jan. 17/62	Feb. 14	March 14	April 11	June 12/62
Time		10:00a.m.	10:40a.m.	2:00p.m.	12:30p.m.	1:00p.m.	2:50p.m.	12:35p.m.	3:00p.m.
Wind, mphr.		--	CALM	CALM	CALM	CALM	CALM	5	CALM
Light, fo.		1000	1000+	900	1000+	850	1000+	1000+	
pH		8.7	7.25	7.7	7.1	7.4	7.4	7.6	8.70
D.O. ppm		16.6	1.4	0.2	NIL	NIL	NIL	NIL	17.4
Temperature °C.		7	0.5	0.5	0.5	0.1	0.1	1.5	21
Alkalinity, ppm	pp	25	--	--	--	--	--	--	27
	MO	335	475	575	585	500	570	80	237
Odor, T.O.N.		5	2	200	5000	2000	2000	Musty 10	—
B.O.D., ppm		36.5	4	11	59	106	120	9	44
Nitrogens, ppm	Total	--	18.1	29.5	34.7	36.0	47.0	7.6	
	Ammonia	9.2	29.0	13.0	28.6	24.0	45.0	10.0	6.0
	Nitrite	--	0.054	0.005	NIL	NIL	0.016	0.060	
	Nitrate	0.47	0.125	0.24	0.438	NIL	0.200	0.075	
Total Solids ppm	Total	923	578	1277	1304	1025	1127	152	810
	Volatile	273	157	291	313	294	291	88	234
Suspended Solids, ppm	Total	108	23	3	21	30	27	12	70
	Volatile	68	11	3	21	30	27	12	70
Chlorides ppm		94	120	140	122	122	112	16	
Sulfates ppm		300	310	300	280	350	285	82	
Phosphates ppm		0.34		33	47	21	40	3.7	
Detergents ppm		--		6.6	6.6	8.8	5.7	NIL	
Ice, feet		--	0.5	3.0	1.0	2.0	2.0	--	--
Liquid, feet		--	4.0	5.0	4.0	3.0	3.0	2.0	2.0
Overflow		--	--	--	--	--	--	--	--

THESE RESULTS WERE NOT PLOTTED ON GRAPHS

SEWAGE POND STUDY

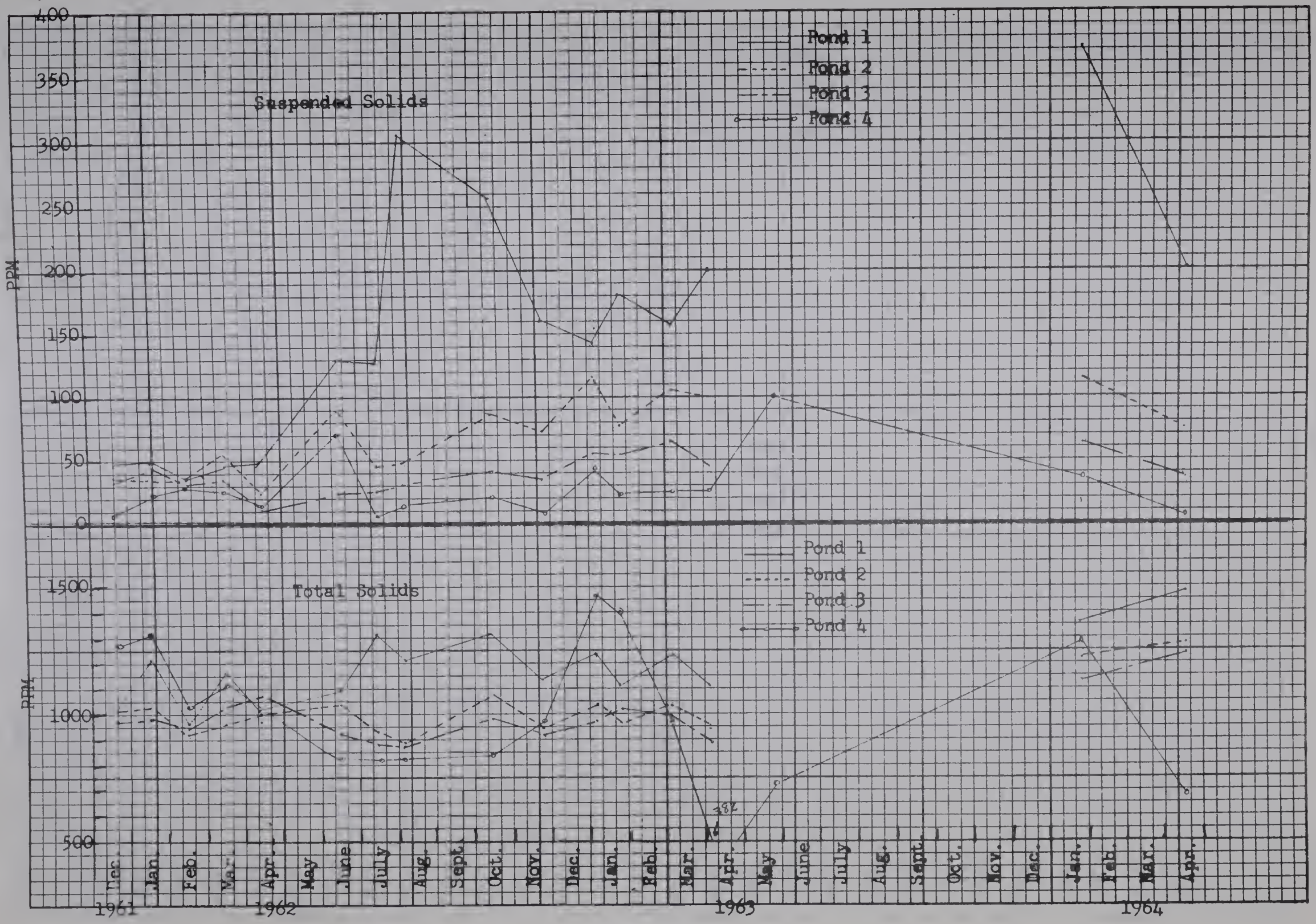
Location Stony Plain Pond 4 Sampling Point Outfall of #4

Date		July 11/62	Aug. 2	Oct. 11	Nov. 21	Jan. 3/63	Jan.23/63	Mar. 7	April 3/63
Time		12:45	1:50p.m.	2:00p.m.	1:00p.m.	1:40 pm	2:00p.m.	12:20p.m.	2:10p.m.
Wind, mphr.		CALM	5	10	5	CALM	CALM	15	CALM
Light, fo.		CLOUDY	Hazy	900	1000	1000+	500	1000+	1000 +
pH		8.0	7.6	7.8	7.9	7.95	7.7	7.65	7.6
D.O. ppm		0.9	2.3	3.4	0.9	NIL	NIL	NIL	1.8
Temperature °C.		18	19	10	5	2	0.5	0.5	3
Alkalinity, ppm	pp	--	--	--	--	--	--	--	--
	MO	305	325	370	400	775	775	455	165
Odor, T.O.N.		—	Musty 8	Musty 8	Musty 8	400	400	200	50
B.O.D., ppm		7	6	4.0	7	113	128	110	19
Nitrogens, ppm	Total Ammonia	7.5	14.5	15	15.8	57	44.5	33.5	8.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	802	805	844	970	1466	1400	994	382
	Volatile	195	200	198	196	390	332	310	106
Suspended Solids, ppm	Total	5	14	20	8	45	24	26	27
	Volatile	5	3	20	6	37	15	26	12
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet		--	--	--	0.2'	½'	1½'	3'	1.0
Liquid, feet		2.0				1'	1'	1'	3.5
Overflow		NO	NO	NO	YES	NO	NO	NO	NO

SEWAGE POND STUDY

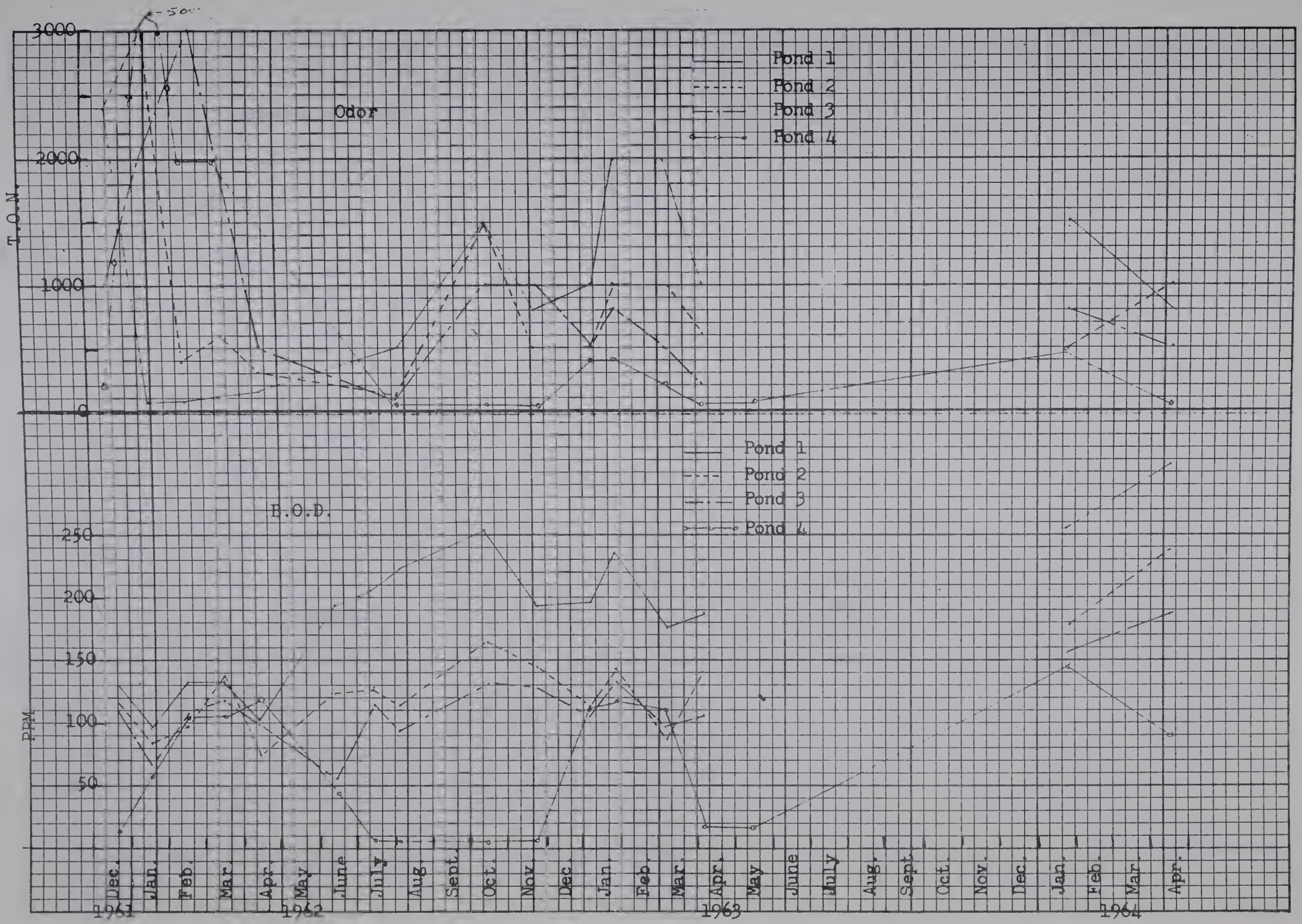
Location Stony Plain Pond 4 Sampling Point Outfall of #4

Date		May 22	Jan.22/64	April 15/64
Time		2:20p.m.	1:55p.m.	4:00p.m.
Wind, mphr.		5	CALM	CALM
Light, fo.		1000+	1000+	800
pH		9.4	7.2	7.5
D.O. ppm		28	NIL	NIL
Temperature °C.		19	1	3
Alkalinity, ppm	pp	50	--	--
	MO	90	680	375
Odor, T.O.N.		20	500	20
B.O.D., ppm		16	145	90
Nitrogens, ppm	Total Ammonia	4.5	50	21
	Nitrite			
	Nitrate			
Total Solids ppm	Total	716	1295	692
	Volatile	185	337	205
Suspended Solids, ppm	Total	100	38	9
	Volatile	72	24	7
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
color		green		
Ice, feet			2'	--
Liquid, feet			1'	1.5
Overflow		NO	NO	YES



STONY PLAIN

Figure 20



STONY PLAIN

Figure 20

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Ammonia Nitrogen

PPM

60
50
40
30
20
10
0

Pond 1
Pond 2
Pond 3
Pond 4

Alkalinity

PPM

700
600
500
400
300
200

Pond 1
Pond 2
Pond 3
Pond 4

Dec. 1961 Jan. Feb. Mar. 1962 Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. 1963 Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. 1964 Mar. Apr.

STONY PLAIN

Figure 20

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Figure 20

Temperature

°C

25
20
15
10
5

Pond 1
Pond 2
Pond 3
Pond 4

pH

9.5
9.0
8.5
8.0
7.5
7.0

Pond 1
Pond 2
Pond 3
Pond 4

Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. APRIL

1961 1962 1963 1964

Stony Plain

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THREE HILLS

The Town of Three Hills is served by a four pond short detention system. The ponds, each 0.12 acres in size, are operated in series with the effluent discharged to a natural run-off channel connecting to Three Hills Creek which empties into the Red Deer River. This system serves a population of 1,400, a Bible Institute of about 1,400 and a creamery producing about 15,000 gallons of milk per month.

Two composite raw sewage samples, and three pond samples were obtained from the system. Results of the chemical analyses are shown on the data sheets.

Considering the March sample as winter conditions, and the June and July samples as summer, the B.O.D. reductions of the entire system were 45.9% and 79.4%, respectively. In each case, the B.O.D. removed by each successive pond decreased with detention time.

This system is one of the few in the province which have odor problems. On June 3, 1964 very high threshold odor numbers were obtained from the pond samples, the maximum being 10,000. At that time odors were detectable at about 1,500 feet from the ponds. It could not be established what source or sources were producing these odors. Except for the high total solids content other chemical characteristics of the raw sewage were similar to those of other centers.

Table 12

SEWAGE POND STUDY

Location		Three Hills		Sampling Point					
		RAW SEWAGE		POND NO. 1			POND NO. 2		
Date		June 3/64	June 4/64	July 10/63	Mar. 4/64	June 3/64	July 10/63	Mar. 4/64	June 3/64
Time		8:00 am - 8:00 pm	8:00 am - 8:00 pm						
Wind, mphr.				10	Calm	20	10	Calm	20
Light, fo.				1000+	1000+	1000+	1000+	1000+	1000+
pH		7.85	7.80	7.5	7.85	7.55	7.85	7.9	7.7
D.O. ppm				Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		Varied 12-15	Varied 14-15	19	6	17	19	3	14
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	895	865	885	925	925	965	975	1020
Odor, T.O.N.		200	200	3000	300	10000	2000	200	5000
B.O.D., ppm		284	439	175	293	256	110	221	174
Nitrogens, ppm	Total Ammonia	62.5	54.0	40.5	53.8	56.0	35.2	53.8	62.5
	Nitrite								
	Nitrate								
Total Solids ppm	Total	2093	2203	1759	2083	1931	1703	1947	1894
	Volatile	391	504	250	372	270	240	249	220
Suspended Solids, ppm	Total	336	284	70	230	100	72	74	76
	Volatile	292	250	64	172	84	60	56	64
Chlorides ppm									
Sulfates ppm									
Phosphates ppm									
Detergents ppm									
Ice, feet				-	-	-	-	In spots	-
Liquid, feet									
Overflow				Yes	Yes	Yes	Yes	Yes	Yes

SEWAGE POND STUDY

Location		Three Hills			Sampling Point		
		Pond No. 3			Pond No. 4		
Date		July 10/63	Mar. 4/64	June 3/64	July 10/63	Mar. 4/64	June 3/64
Time							
Wind, mphr.		10	Calm	20	10	Calm	20
Light, fo.		1000+	1000+	1000+	1000+	1000+	1000+
pH		8.2	7.8	7.9	8.4	7.9	8.05
D.O. ppm		Nil	Nil	Nil	Nil	Nil	Nil
Temperature °C.		19	2	15	19	2	14
Alkalinity, ppm	pp	-	-	-	5	-	-
	MO	965	955	1035	950	1000	1095
Odor, T.O.N.		600	300	5000	200 Grassy	200	2000
B.O.D., ppm		68	198	129	54	196	96
Nitrogens, ppm	Total Ammonia	32.0	50.2	44.4	28.2	57.5	49.0
	Nitrite						
	Nitrate						
Total Solids ppm	Total	1702	1986	1915	1679	1958	1922
	Volatile	236	353	252	212	319	240
Suspended Solids, ppm	Total	76	58	66	78	55	62
	Volatile	60	47	48	66	33	48
Chlorides ppm							
Sulfates ppm							
Phosphates ppm							
Detergents ppm							
Ice, feet		-	About 0.3	-	-	About 0.3	-
Liquid, feet							
Overflow		Yes	Yes	Yes	Yes	Yes	Yes

WETASKIWIN

The City of Wetaskiwin with a population of 5,600 is served by two sewage pond systems. One system is located to the southeast and the other to the northeast of the city. Each system is discussed separately and referred to by their location relative to the city.

(A) Southeast System:

This system, consisting of four long detention ponds, serves a population of 1,100 plus a milk condensery plant which produces about 215,000 pounds of milk daily. Three ponds were investigated during the period of April 1963 and March 11, 1964. The fourth pond, see sketch, was constructed in the fall of 1963 and was in operation just before freeze-up. Due to ice conditions, samples from this pond could not be obtained and therefore has not been considered in the evaluation of this system. The three ponds are designed so that parallel or series operation is permissible. During the investigation the system was operated in one of the following patterns:
(a) two ponds in series, flow from pond one to pond three;
(b) three ponds in series, flow from pond one to pond two to pond three;
(c) three ponds in parallel. The three types of operation were tried to alleviate the very high odors rising from the lagoons.

The milk condensery plant being the major contributor has greatly overloaded the sewage ponds. From five composite raw sewage samples the average load to the first pond was 248 lb. B.O.D./acre/day which is far above the allowable of 60 lb. B.O.D./acre/day for an aerobic pond. The high loading no doubt caused the very high odors to persist throughout the spring and summer of 1963.

From B.O.D. analysis, the ponds gave a high degree of treatment when operated in series; 74.4% B.O.D. reduction in the spring for two ponds, and 90.5% in the summer and fall for three ponds. Although satisfactory treatment was obtained from both sets of operations, the odor problem still existed.

After the construction of the fourth pond, the other three ponds were operated in parallel with some overflow between ponds 3 and 4. Although the loading to each cell was reduced by the parallel operation, the B.O.D. reduction was very small; the maximum B.O.D. reduction was 24.1%. It should be realized the switch-over from series to parallel occurred after freeze-up. However, samples obtained on July 8, 1964 gave the following B.O.D. reductions: (a) pond 1 - 67.4%; (b) pond 2 -73.1% (c) pond 3 - 89.4%. A short period of odor was experienced from the first three ponds during the spring thaw in 1964. Recirculation of the liquid from pond four to the other ponds was successful in alleviating this odor. Recirculation rates were not available. It seems that parallel operation with some recirculation is the best set-up for this system. Besides providing a satisfactory degree of treatment, the odor trouble experienced the previous year was corrected.

During 1963 when the odor intensity was very high, jar tests using various chemicals were conducted in the laboratory of the Department of Public Health. Also several chemicals on a small basis were tried under field conditions at the site of the lagoons. The chemicals, sodium nitrate, lime, and phosphate, did not show any significant improvement in the odor level.

By comparison to other aerobic systems in the province, suspended solids were high throughout the year and ammonia-nitrogen concentrations were very low during the summer months.

(B) Northeast System:

The northeast lagoons, consisting of three short detention and two long detention ponds, began operation in the fall of 1962. This system serves the remaining population of 4,500, the normal commercial outlets in the city, and a creamery producing about 8,000 lbs. of butter per day and 1,000 units of milk per day.

The raw sewage enters the first cell by gravity; then is pumped to the second short detention pit; and from here it flows by gravity in a series pattern to the other ponds. The first cell is a 19 foot excavation with a normal operating depth of about five feet. The other two short detention ponds have built-up berms and are 15 feet deep while the long detention ponds are 6 and 7 feet deep.

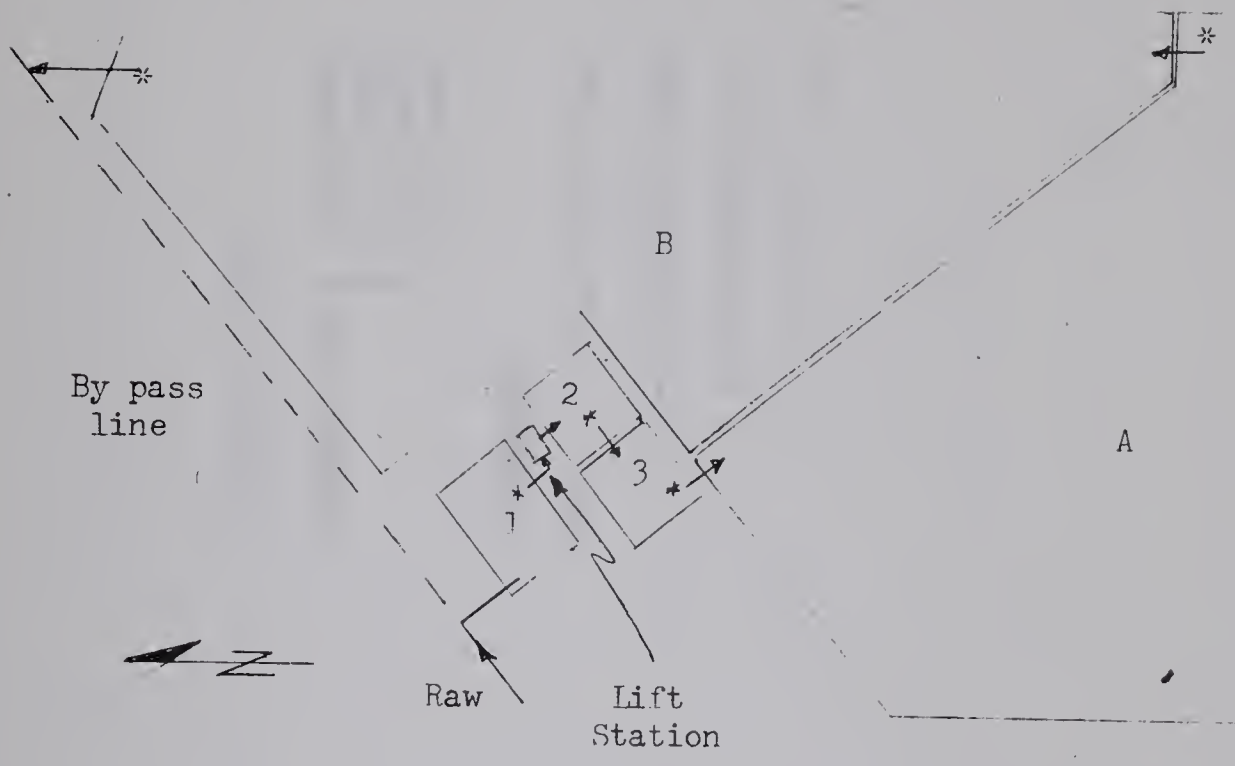
The raw sewage B.O.D. averaged 266 ppm as compared to the effluent from pond one of 275 ppm. It appears there was an increase in the biochemical oxygen demand of the sewage during the detention period of 1.83 days. It is quite possible the dairy wastes were missed during the sampling of the raw sewage and hence the intermitten discharge of the dairy wastes have probably given high B.O.D. values in the ponds. The overall B.O.D. reduction provided by the three short detention cells was only 12.0%; much below the expected treatment for an anaerobic system.

However, with the addition of the two long detention ponds a high degree of treatment resulted. A B.O.D. reduction of 88.6% was obtained for the entire system. Dissolved oxygen was present in long detention pond B till January. Only during a short period of the year was this pond under anaerobic conditions.

The chemical components, other than B.O.D., of the anaerobic cells were in the expected range.

Odors were of moderate to strong intensity near the short detention ponds, but were not detectable at distances greater than several hundred feet. Odors near the long detention ponds were at a minimum throughout the year.

Plan of
Wetaskiwin Northeast
Sewage Ponds



Scale 1" = 300'
* - Sampling Points

Pond	Area (Acres)	Volume (Million Gal.)
1	0.36	0.490 @ 5' Depth
2	0.087	0.414 @ 15' Depth
3	0.087	0.414 @ 15' Depth
A	21.6	35.3 @ 6' Depth
B	12.2	23.2 @ 7' Depth

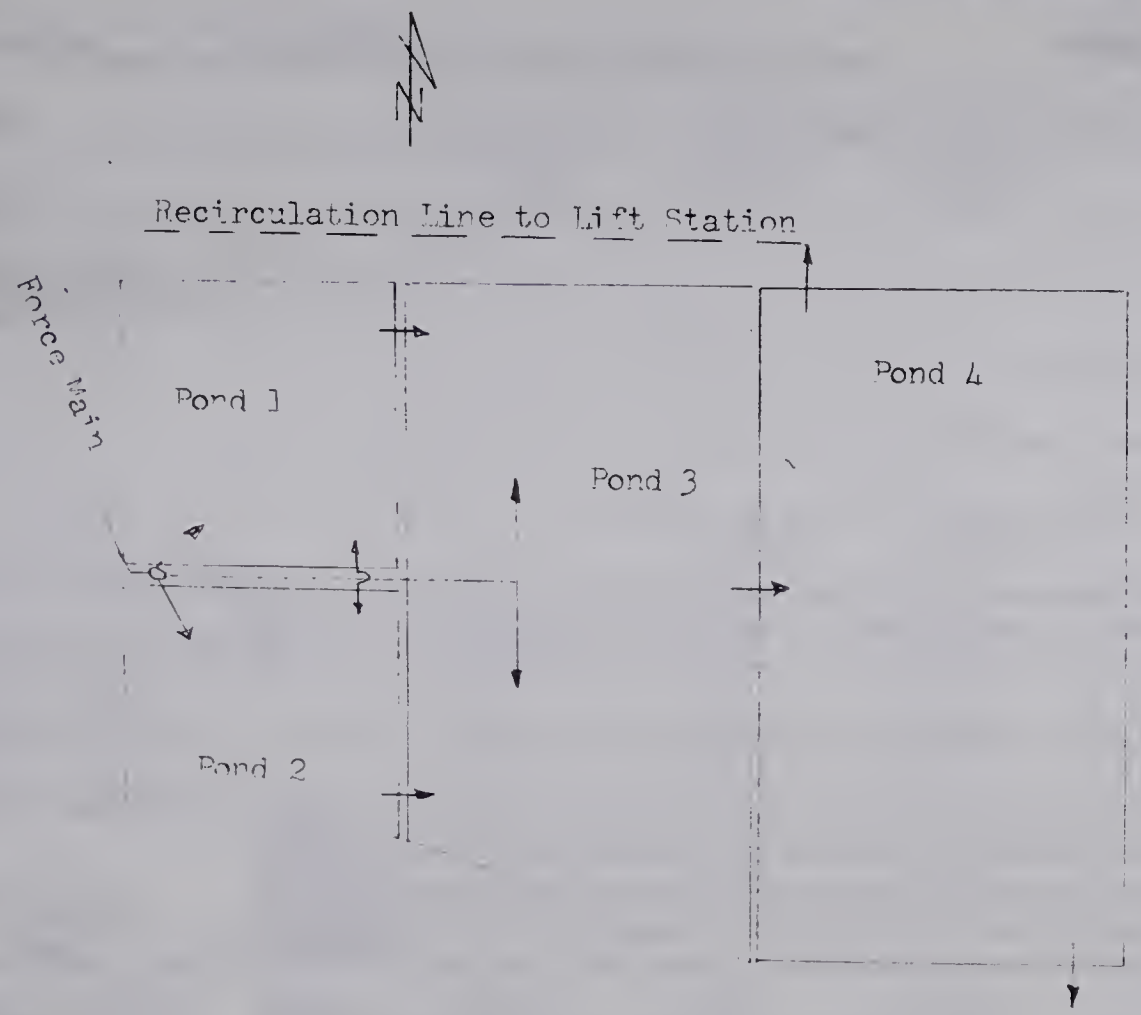
Figure 21

Table 13A

SEWAGE POND STUDY

Location Wetaskiwin n.e. raw sewage **Sampling Point** last Manhole before Pond #1

Date		Nov.6/63	May 20/64	May 21/64				
Time		8a.m.-12 Mid.	8a.m.-8p.m.	8a.m.-8p.m.				
Wind, mphr.								
Light, fc.								
pH		8.0	7.8	8.1				
D.O. ppm								
Temperature °C.		12	varied 9-12	varied 9-11				
Alkalinity, ppm MO	pp	--	--	--				
		765	725	665				
Odor, T.O.N.		200	200	200				
B.O.D., ppm		270	254	274				
Nitrogens, ppm	Total							
	Ammonia	45.5	46.0	38.8				
	Nitrite							
	Nitrate							
Total Solids ppm	Total	1755	1466	1525				
	Volatile	448	375	433				
Suspended Solids, ppm	Total	304	320	432				
	Volatile	236	252	212				
Chlorides ppm								
Sulfates ppm								
Phosphates ppm								
Detergents ppm								
Ice, feet								
Liquid, feet								
Overflow								



PLAN OF WETASKIWIN SOUTHEAST PONDS

Scale 1" = 300'

Area:- Pond 1 - 2.8 Acres
2 - 2.6 Acres
3 - 6.9 Acres
4 - 9.3 Acres

Capacity:-

Pond 1 - 3.44 Million Gals. @ 4.5 ft. Depth.

2 - 3.20 Million Gals. @ 4.5 ft. Depth.

3 - 12.8 Million Gals. @ 6.8 ft. Depth.

4 - 12.7 Million Gals. @ 5.0 ft. Depth.

A-120

Figure 22

Table 13B

SEWAGE POND STUDY

Location Wetaskiwin Pond No. 1 Sampling Point Outfall at Pond 1

Date		Jan.30/63	Mar.27	Nov.27	Jan. 2	Mar.11/64
Time		1[00]p.m.	11[50]a.m.	11[00] AM	11[45] AM	10[30]a.m.
Wind, mphr.		Calm	Calm	Calm	15	Calm
Light, fo.		800	1000	800	1000 +	800
pH		7.9	7.7	7.5	7.6	7.6
D.O. ppm		NIL	NIL	NIL	NIL	NIL
Temperature °C.		1	9	5	4	4
Alkalinity, ppm	pp	--	--	--	--	--
	MO	735	600	560	1075	790
Odor, T.O.N.		800	—	700	1000	1000
B.O.D., ppm		340	183	205	308	337
Nitrogens, ppm	Total Ammonia	49.5	42.5	38.5	52.0	54.5
	Nitrite					
	Nitrate					
Total Solids ppm	Total	1349	1083	1130	1302	1393
	Volatile	328	224	225	308	334
Suspended Solids, ppm	Total	126	96	122	132	132
	Volatile	116	68	82	122	106
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Ice, feet		1.0	--	--	--	0.2
Liquid, feet						
Overflow *		YES	YES	YES	YES	YES

* PUMPED

Table 13C

SEWAGE POND STUDY

Location: Wetaskiwin Pond No. 2 — Sampling Point: Outfall at Pond 2

Date		Jan. 30/63	Mar. 27	Nov. 27	Jan. 2/64	Mar. 11/64
Time		1:30 pm	noon 12:00	10:50 am	11:35 AM	10:25 AM
Wind, mphr.		Calm	Calm	Calm	15	Calm
Light, fo.		800	1000+	800	1000+	800
pH		7.95	7.8	7.6	7.6	7.7
D.O. ppm		Nil	Nil	Nil	Nil	Nil
Temperature °C.		1	8	2	1.5	2
Alkalinity, ppm	pp	-	-	-	-	-
	MO	800	575	770	825	810
Odor, T.O.N.		1000	1000	800	500	400
B.O.D., ppm		264	167	221	281	300
Nitrogens, ppm	Total Ammonia	51	38.5	45.0	55.5	57.5
	Nitrite					
	Nitrate					
Total Solids ppm	Total	1366	1047	1419	1290	1368
	Volatile	278	221	351	288	321
Suspended Solids, ppm	Total	92	78	142	126	98
	Volatile	84	52	104	116	82
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Ice, feet		2.0	-	Thin ice	Thin ice	0.5
Liquid, feet						
Overflow		Yes	Yes	Yes	Yes	

Table 13D

SEWAGE POND STUDY

Location: Wetaskiwin #3 — Sampling Point: Outfall of #3

Date		Mar. 27/63	Nov. 27	Jan. 2/64	Mar. 11/64
Time		12:05 pm	10:45 AM	11:30 AM	10:15 AM
Wind, mphr.		Calm	Calm	15	Calm
Light, fo.		1000+	800	1000+	800
pH		7.8	7.45	74	7.65
D.O. ppm		Nil	Nil	Nil	Nil
Temperature °C.		8	2	1.5	1
Alkalinity, ppm	pp	-	-	-	-
	MO	540	725	825	1085
Odor, T.O.N.		500	1000	400	400
B.O.D., ppm		156	271	261	247
Nitrogens, ppm	Total Ammonia	39.5	45.7	55.5	57.0
	Nitrite				
	Nitrate				
Total Solids ppm	Total	1060	1497	1291	1565
	Volatile	215	432	301	280
Suspended Solids, ppm	Total	88	141	110	48
	Volatile	52	99	108	36
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet		-	Thin ice	Thin ice	0.5
Liquid, feet					
Overflow		Yes	Yes	Yes	Yes
			Melting around edges		

Table 13E

SEWAGE POND STUDY

Location: Wetaskiwin Pond A (Long Det.) — Sampling Point: Outfall of Pond A

		Mar. 27/63	Nov. 27/63	Jan. 2/64	Mar. 11/64
Date					
Time		12:10 pm	10:30 AM	11:20 AM	10:00 am
Wind, mphr.		Calm	Calm	15	Calm
Light, fo.		1000+	800	1000+	800
pH		7.8	8.1	7.5	7.8
D.O. ppm		Nil	Nil	Nil	Nil
Temperature °C.		8	1	0.5	1
Alkalinity, ppm	pp	-	-	-	-
	MO	440	965	1400	1140
Odor, T.O.N.		200	40	100	100
B.O.D., ppm		105	103	>160 ~~1160~~	241
Nitrogens, ppm	Total				
	Ammonia	34	34.5	51.0	64.5
	Nitrite				
	Nitrate				
Total Solids ppm	Total	827	1697	1902	1649
	Volatile	157	302	295	278
Suspended Solids, ppm	Total	18	72	70	38
	Volatile	15	55	68	30
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet		0.2	0.5	1.5	2.5
Liquid, feet			3.0	2.5	3.0
Overflow		No	YES	YES	YES

Light green

Table 13F

SEWAGE POND STUDY

Location: Wetaskiwin Pond B (Long) — Sampling Point: Outfall

Date		Nov. 27/63	Jan. 2/64	Mar. 11/64
Time		10:15 AM	11:00 AM	9.45 am
Wind, mphr.		Calm	15	Calm
Light, fo.		800	1000+	800
pH		9.1	8.8	8.2
D.O. ppm		12.8	0.8	Nil
Temperature °C.		1	0.5	1
Alkalinity, ppm	pp	110	125	-
	MO	535	725	1140
Odor, T.O.N.		10	10	50
B.O.D., ppm		3.0	11	78
Nitrogens, ppm	Total			
	Ammonia	2.5	4.5	33.5
	Nitrite			
	Nitrate			
Total Solids ppm	Total	1404	1618	1859
	Volatile	202	181	245
Suspended Solids, ppm	Total	32	40	10
	Volatile	20	38	9
Chlorides ppm				
Sulfates ppm				
Phosphates ppm				
Detergents ppm				
Ice, feet		0.5	1.5	2.5
Liquid, feet		4.5	3.5	3.5
Overflow		No	No	Leaking
		Very light green	Clear	

SOUTH EAST POND

Table 14A

SEWAGE POND STUDY

Location Wetaskiwin Raw (SOUTHEAST) Sampling Point AT LIFT STATION

Date		April 23 - 24/63	June 12 - 13/63	Nov. 6/63	May 20/64	May 21/64
Time		3:05 pm - 9:55 pm 6:05 am - 8:50 am	24 hour composite	17 hour composite	8:00 am - 8:00 pm	8:00 am - 8:00 pm
Wind, mphr.						
Light, fo.						
pH		7.35	7.8	7.75	6.65	8.45
D.O. ppm						
Temperature °C.				13	14-16	14-16
Alkalinity, ppm	pp MO	- 655	- 665	- 630	- 470	11 621
Odor, T.O.N.		400		300	1000 dairy & sewage	500
B.O.D., ppm		544	840	397	1300	531
Nitrogens, ppm	Total Ammonia	17.0	24.0	34.5	35.0	23.8
	Nitrite					
	Nitrate					
Total Solids ppm	Total	1729	2076	1547	1963	1742
	Volatile	496	698	482	953	457
Suspended Solids, ppm	Total	332	256	340	542	320
	Volatile	288	224	220	514	208
Chlorides ppm						
Sulfates ppm						
Phosphates ppm						
Detergents ppm						
Ice, feet						
Liquid, feet						
Overflow						

Table 14B

SEWAGE POND STUDY

Location Wetaskiwin #1 (SOUTHEAST) Sampling Point

Date		Apr. 19/63	May 1	May 6	May 29	June 27/63	Aug. 7	Nov. 6	Jan. 2/64
Time		10:05 am				10:45 am	10:40 am	1:30 pm	9:50 am
Wind, mphr.		5	30	5	5	Calm	20	Calm	15
Light, fo.			1000+	1000+	1000+	Cloudy	1000+	500	1000+
pH	Field	7.50	7.5						
	Lab.	7.65	7.8	7.85	8.1	8.0	8.30	7.50	7.20
D.O. ppm		-	-	-	-	-	-	Nil	Nil
Temperature °C.		6	12	7	17	17	20	2	0.5
Alkalinity, ppm	pp	-	-	-	-	-	-	-	-
	MO	620	665	640	700	830	950	960	960
Odor, T.O.N.		500	700	500	700	500 sewage	200 sewage sweet	700 pig pen	2000
B.O.D., ppm		265	255	221	229	290	222	228	600
Nitrogens, ppm	Total Ammonia	35	27.5		26	17	5.5	19.0	57.0
	Nitrite			0.05					
	Nitrate	0.08		0.80					
Total Solids ppm	Total	1137	1218		1320	1515	1843	1862	1980
	Volatile	219	237		241	339	505	821	530
Suspended Solids, ppm	Total	118	82		120	152	350	300	258
	Volatile	116	80		114	124	340	284	242
Chlorides ppm				185					
Sulfates ppm			80		200				
Phosphates ppm									
Detergents ppm									
REMARKS						← ACTI-ZEME USED			
Ice, feet		-	-					0.2	1.0
Liquid, feet									2.0
Overflow		Yes							No

SEWAGE POND STUDY

Location Wetaskiwin #1 (SOUTHEAST) Sampling Point

Date		Mar. 11/64
Time		11:15 am
Wind, mphr.		Calm
Light, fo.		800
pH		7.3
D.O. ppm		Nil
Temperature °C.		1
Alkalinity, ppm	pp	-
	MO	865
Odor, T.O.N.		2000
B.O.D., ppm		567
Nitrogens, ppm	Total	
	Ammonia	55
	Nitrite	
	Nitrate	
Total Solids ppm	Total	1806
	Volatile	519
Suspended Solids, ppm	Total	206
	Volatile	190
Chlorides ppm		
Sulfates ppm		
Phosphates ppm		
Detergents ppm		
Ice, feet		2.5
Liquid, feet		
Overflow		No

Table 14C

SEWAGE POND STUDY

Location Wetaskiwin #2 (Camrose) Sampling Point

Date		May 29/63	June 27	Aug. 7	Aug. 30	Nov. 6	Jan.2/64	Mar.11/64
Time			10:30 AM	10:15 AM		1:45 pm	10:00a.m.	11:05a.m.
Wind, mphr.		5	Calm	20		Calm	15	Calm'
Light, fo.		1000+	Cloudy	1000+		500	1000+	800
pH		8.3	8.35	8.35	8.20	7.4	6.9	7.45
D.O. ppm		--	--	--		--	NIL	NIL
Temperature °C.		17	17	20		2	0.5	1
Alkalinity, ppm	pp	--	--	--	--	--	--	--
	MO	730	830	835	935	915	1170	665
Odor, T.O.N.		700	300	50 sweet	1000 sweet sewage	800 pig pen	2000 pig pen	2000
B.O.D., ppm		173	150	118	158	324	525	570
Nitrogens, ppm	Total Ammonia	17	13.5	2.5	12.75	26	51	43
	Nitrite							
	Nitrate							
Total Solids ppm	Total	1613	1686	1777	--	1831	1975	1562
	Volatile	353	392	432	--	842	447	540
Suspended Solids, ppm	Total	168	550	290	258	260	180	222
	Volatile	168	280	280	222	232	176	196
Chlorides ppm								
Sulfates ppm		225						
Phosphates ppm								
Detergents ppm								
Ice, feet						0.2	1.0	2.5
Liquid, feet							2.0	
Overflow							No	No

Table 14D

SEWAGE POND STUDY

Location Wetaskiwin #3 Sampling Point

Date		April 19/63	May 1	May 6/63	May 29	June 27/63	July 18	Aug. 7/63	Aug. 14/63
Time		9:50 am				10:15 am		10:30 am	3:45 pm
Wind, mphr.		5	30	5	5	Calm		20	
Light, fo.			1000+	1000+	1000+	Cloudy		1000+	
pH	Field	7.40	7.6						
	Lab.	7.65	7.9	7.95	8.1	8.5	8.45	8.55	
D.O. ppm		-	-	-	-	7.6	-	11.0	10.0
Temperature °C.		5	9	7	17	17		19	
Alkalinity, ppm	pp	-	-	-	-	15	50	25	
	MO	425	840	825	845	825	815	875	
Odor, T.O.N.		300	600	500	300	50 grassy	20 musty	20 grassy	
B.O.D., ppm		155	222	182	135	97	40	35	
Nitrogens, ppm	Total Ammonia	23.5	28		24.5	4.6		4.5	
	Nitrite			0.02					
	Nitrate	0.002		0.14					
Total Solids ppm	Total	778	1362		1239	1488		1570	
	Volatile	152	252		244	270		242	
Suspended Solids, ppm	Total	82	80		112	128		96	
	Volatile	80	76		108	108		92	
Chlorides ppm				190					
Sulfates ppm			62.5		185				
Phosphates ppm									
Detergents ppm									
Ice, feet									
Liquid, feet									
Overflow		No	No					Yes	

SEWAGE POND STUDY

Location Wetaskiwin #3 Sampling Point

Date		Aug. 30/63	Nov. 6	Jan. 2/64	Mar. 11/64
Time			1:50 pm	9:40 am	10:50 am
Wind, mphr.			Calm	15	Calm
Light, fo.			500	1000+	800
pH		8.45	8.3	7.3	7.35
D.O. ppm			Nil	Nil	Nil
Temperature °C.			2	0.5	1
Alkalinity, ppm	pp	20	-	-	-
	MO	880	1000	1400	990
Odor, T.O.N.		20 sewage	300	1500 pig pen	1000
B.O.D., ppm		63	50	565	577
Nitrogens, ppm	Total				
	Ammonia	8.1	8	49	55
	Nitrite				
	Nitrate				
Total Solids ppm	Total	-	1848	2363	1986
	Volatile	-	362	561	540
Suspended Solids, ppm	Total	182	148	228	210
	Volatile	136	120	228	192
Chlorides ppm					
Sulfates ppm					
Phosphates ppm					
Detergents ppm					
Ice, feet			0.2	1.0	2.5
Liquid, feet				2.0	
Overflow				No	No

STABILIZATION PONDS SERVING SCHOOLS

Approximately 35 schools in the province utilize sewage ponds for their waste disposal system. Several of these systems near the City of Edmonton were spot checked to determine the quality of the liquid. The four schools selected had long detention ponds with detention periods of about one school year (10 months). The student enrollment at these schools varied from 300 at Colchester to 900 at Ardrossan.

The chemical analysis of the samples obtained showed the systems were functioning quite well. Compared to long detention ponds serving towns and villages, the liquid had a much better quality both during summer and winter. Odors were at a minimum during the open water seasons.

Chemical Analyses are given in Table 15.

Table 15

CHEMICAL ANALYSES OF SCHOOL PONDS

	Ardrossan			Salisbury		
	June 15/62	Aug.15/62	Feb.20/64	June 15/62	Aug.19/62	Feb.20/64
pH	10.2	8.6	8.4	10.35	9.3	9.3
D.O.-ppm	17.2	3.6	Nil	11.7	11.2	Nil
Temperature °C	18	14	-	17	14	-
Alkalinity-ppm	675	520	1300	460	1560	650
Odor-T.O.N.		3 Musty	20		3 Musty	60
B.O.D.-ppm	17	10	48	42	11	22
Ammonia Nitrogen-ppm	2.5	4.5	42.0	2.0	2.0	28.2
Total Solids-T.	1007	1015	1537	909	1164	1050
-V.	168	115	160	38	122	113
Suspended Solids-T.	34	12	9	21	34	3
-V.	21	12	9	13	32	3
Ice Ft.			2.5			2.0

continued.....

Table 15 (con't)

CHEMICAL ANALYSES OF SCHOOL PONDS

	Ellerslie				Colchester
	Pond 1		Pond 2		
	June 15/62	Aug.19/62	June 15/62	Aug.19/62	Feb.20/64
pH	9.75	8.15	9.4	8.2	8.2
D.O.-ppm	3.1	0.8	4.6	5.8	Nil
Temperature °C	18	14	18	15	-
Alkalinity-ppm	365	580	215	300	1050
Odor-T.O.N.	-	4 Musty	-	2 Musty	200
B.O.D.-ppm	31	5	10	2	130
Ammonia Nitrogen-ppm	4	11	1.4	0.25	81.5
Total Solids-T.	1077	1301	696	881	2177
-V.	160	147	100	129	284
Suspended Solids-T.	77	10	15	16	146
-V.	32	8	9	14	82
Ice Ft.					Approximately 8" of Liquid

APPENDIX B

TABULATION OF LOADINGS AND REDUCTIONS OF B.O.D. AND SUSPENDED SOLIDS

	Page
1) Short Detention Ponds	
a) B.O.D.	
Yearly Performance	B-1
Winter Performance	B-3
Summer Performance	B-5
b) Suspended Solids	
Winter Performance	B-6
c) Graph of Yearly B.O.D. Performance For Short Detention Ponds	B-8
2) Long Detention Ponds	
a) B.O.D.	
Yearly Performance	B-9
Winter Performance	B-10
Summer Performance	B-11

Table 16

YEARLY BOD PERFORMANCE - SHORT DETENTION PONDS

Location	BOD Loading ***	BOD Removed ***	% BOD Reduction (As single Units)	Accumulated % BOD Reduction	Detention Time - Days
1) Camrose					
Primary 1	3.71	1.54	41.7	41.7	6.20
Primary 2	2.34	0.17	7.45	46.1	5.75
Secondary 1	3.36	0.50	15.0	57.2	3.45
Secondary 2	3.85	0.26	5.6	45.6	3.45
Nov.30/61 - Oct.4/62					
Secondary 2	2.85	0.11	3.8	58.6	3.45
Nov.28/62 - Mar.18/64					
2) Innisfail					
Dec.13/61- Sept.6/62					
Pond 2	8.50	2.40	28.3	28.3	1.93
Pond 3	6.10	0.81	13.3	37.8	1.93
Nov.14/62-Sept.11/63					
Pond 1	8.50	1.62	19.2	19.2	1.93
Pond 4	6.90	0.97	14.2	30.5	1.93
Pond 3	5.90	0.29	4.94	34.0	1.93
3) Medicine Hat					
*Jan.17/62-May23/62					
Pond 1	5.94	3.54	59.6	59.6	2.14
Pond 2	2.31	0.70	29.3	71.5	2.14
Pond 3	1.70	0.35	20.7	77.4	2.14
Pond 4	1.35	0.09	2.4	77.8	2.14
*Oct. 15/62					
Pond 1	8.96	5.46	61.0	61.0	2
Pond 2	3.50	0.31	0.9	61.4	2
Pond 3	3.46	7.5	21.6	69.6	2
Pond 4	2.72	3.12	11.5	72.4	2
**Aug.6,20 & Sept.18/63					
Pond 1	4.5	3.84	85.5	85.5	4
Pond 2	4.5	3.91	86.8	86.8	4
Pond 3	0.66	0.29	45.2	92.2	4
Pond 4	0.59	0.39	66.1	96.5	4
*Mar.3/64					
Pond 1	8.96	4.09	45.6	45.6	2
Pond 4	4.88	0.94	19.2	56.0	2

* - Series Operation
** - Parallel Operation
*** - lb/1000 ft^3/day

continued.....

Table 16 (con't)

Location	BOD Loading ***	BOD Removed ***	% BOD Reduction (As single Units)	Accumulated % BOD Reduction	Detention Time - Days
4) Stettler					
Pond 1	3.29	0.98	29.9	29.9	5.94
Pond 2	2.19	0.43	19.7	43.8	6.20
5) Stony Plain					
Pond 1	17.7	7.55	42.7	42.7	1.18
Pond 2	10.1	3.16	31.2	60.6	1.18
Pond 3	2.5	3.42	13.9	66.1	3.30
6) Red Deer					
Pond 1	8.03	2.98	37.2	37.2	3.38
Pond 2	5.05	0.96	19.0	49.0	3.38
Pond 3	4.08	0.44	10.8	54.6	3.38
Pond 4	3.64	0.11	3.05	56.0	3.38
Pond 5	3.53	0.13	3.64	57.5	3.38
*Pond 2	10.80	4.75	44.0	44.0	2.03
Pond 3	6.06	1.38	22.7	56.6	2.03
Pond 4	4.68	0.77	16.3	63.8	2.03
Pond 5	3.92	0.49	12.5	68.2	2.03
*Pond 1 By-Passed					
7) Three Hills					
Pond 1	10.1	3.37	33.4	33.4	2.24
Pond 2	6.72	2.04	30.2	53.5	2.24
Pond 3	4.66	1.00	21.4	63.5	2.24
Pond 4	3.67	0.47	12.8	68.2	2.24
8) Wetaskiwin (NE)					
Pond 1	9.08	Negative Reduction			1.83
Pond 2	10.95	1.17	10.7	10.7	1.55
Pond 3	10.00	0.49	4.9	12.0	1.55
9) Drumheller					
Pond 1	2.61	0.91	34.8	34.8	6.75
Pond 2	1.70	0.26	15.4	45.6	7.15
Pond 3	1.51	0.28	18.5	55.6	6.30
Pond 4	1.20	0.18	15.0	62.3	6.50
10) Evansburg					
Pond 1	58.0	30.4	52.3	52.3	1.32
Pond 2		Negative Reduction			

* - Series Operation
** - Parallel Operation
*** - lb/1000 ft^3/day

Table 17

WINTER BOD PERFORMANCE - SHORT DETENTION PONDS
Winter - Dec. 1 to April 1 (Inclusive)

Location	BOD Load *	BOD Removed *	% BOD Reduction (As Single Units)	Accumulated % BOD Reduction
1) Camrose				
Primary 1	3.71	1.53	41.2	41.2
Primary 2	2.36	0.22	9.21	46.6
Secondary 1	3.46	0.27	7.85	52.4
Secondary 2	3.18	0.036	1.14	52.8
2) Innisfail				
Pond 2	8.5	2.56	30.1	30.1
Pond 3	5.94	0.85	14.2	40.0
Pond 1	8.5	1.62	19.1	19.1
Pond 4	6.89	0.81	11.8	28.6
Pond 3	6.06	0.13	2.13	30.1
3) Medicine Hat Jan.17/62- April 1/62				
Pond 1	6.20	4.25	68.4	68.4
Pond 2	1.97	0.43	22.6	75.5
Pond 3	1.52	0.32	21.1	80.6
Pond 4	1.20	0.12	10.0	82.6
4) Stettler				
Pond 1	3.29	0.93	28.2	28.2
Pond 2	2.24	0.28	12.5	37.3
5) Stony Plain				
Pond 1	17.7	8.61	48.8	48.8
Pond 2	9.06	2.68	29.6	64.0
Pond 3	2.26	0.13	5.88	66.1
6) Red Deer				
Pond 1	8.03	2.22	27.8	27.8
Pond 2	5.80	1.45	25.1	45.8
Pond 3	4.33	0.47	11.0	51.7
Pond 4	Negative Reduction			
Pond 5	4.08	0.22	5.43	52.0
Pond 2	10.80	4.13	38.1	38.1
Pond 3	6.58	1.41	21.4	52.1
Pond 4	5.15	0.79	15.4	59.4
Pond 5	4.36	0.43	9.8	63.4
7) Three Hills				
Pond 1	10.1	1.92	19.1	19.1
Pond 2	8.16	2.00	24.6	38.9

* - lb/1000 ft^3/day

continued.....

Table 17 (con't)

Location	BOD Load *	BOD Removed *	% BOD Reduction (As Single Units)	Accumulated % BOD Reduction
7) Three Hills				
Pond 3	6.16	0.64	10.4	45.3
Pond 4	5.51	0.05	0.9	45.9
8) Drumheller				
Pond 1	2.61	0.57	21.7	21.7
Pond 2	1.92	0.29	15.1	33.4
Pond 3	1.84	0.32	17.4	44.8
Pond 4	1.49	0.08	5.36	47.8
9) Evansburg				
Pond 1	58.0	23.1	39.7	39.7
Pond 2		Negative Reduction		

* - lb/1000 ft^3/day

Table 18

SUMMER BOD PERFORMANCE - SHORT DETENTION PONDS

Summer - June 1 to Oct. 1 (Inclusive)

Location	BOD Loading *	BOD Removed *	% BOD Reduction (As Single Units)	Accumulated % BOD Reduction
1) Camrose				
Primary 1	3.71	1.65	44.5	44.5
Primary 2	2.24	0.39	17.6	52.1 55.1
Secondary 1	3.20	0.49	15.3	59.4 -
Secondary 2	2.71 2.98	1.21 1.03	44.6 34.6	77.6 71.6
2) Innisfail				
Pond 2	8.50	2.73	32.0	32.0
Pond 3	5.76	1.01	17.4	43.9
Pond 1	8.5	1.86	21.7	21.7
Pond 4	6.65	1.23	18.5	36.2
Pond 3	5.41	0.72	13.3	44.6
3) Stettler				
Pond 1	3.29	1.21	37.0	37.0
Pond 2	1.97	0.83	42.3	63.6
4) Stony Plain				
Pond 1	17.7	6.26	35.5	35.5
Pond 2	11.4	5.04	44.1	64.0
Pond 3	2.26	0.60	26.9	73.6
5) Red Deer				
Pond 1	8.03	3.75	46.8	46.8
Pond 2	4.30	0.79	18.5	56.5
Pond 3	3.48	0.63	18.0	64.4
Pond 4	2.85	0.49	17.4	71.5
Pond 5	2.36	0.35	14.8	75.0
Pond 2	10.8	5.24	48.4	48.4
Pond 3	5.56	0.15	2.7	49.8
Pond 4	5.42	1.99	36.6	68.1
Pond 5	3.43	0.58	17.0	73.6
6) Three Hills				
Pond 1	10.1	4.08	40.6	40.6
Pond 2	5.98	2.04	33.9	60.8
Pond 3	3.94	1.20	30.3	72.7
Pond 4	2.76	0.67	24.3	79.4
7) Drumheller				
Pond 1	2.61	1.60	61.4	61.4
Pond 2	0.95	0.37	38.9	76.3
Pond 3	0.66	0.01	1.5	76.6
Pond 4	0.63	0.39	61.8	91.0
8) Evansburg				
Pond 1	58.0	30.8	54.0	54.0
Pond 2		Negative Reduction		

* - lb/1000 ft^3/day

Table 19

WINTER SUSPENDED SOLIDS REMOVAL - SHORT DETENTION PONDS

Location	Suspended Load Solids *	Suspended Solids Removed *	% Suspended Solids Reduction (As single units)	Total % Suspended Solids Removed	Detention Time - Days
1) Camrose					
Primary 1	3.86	3.07	79.6	79.6	6.20
Primary 2	0.85	0.12	14.1	85.8	5.75
Secondary 1	1.10	0.13	11.8	87.1	3.45
Secondary 2	0.89	0.25	28.1	91.0	3.45
2) Innisfail					
Pond 2	12.7	8.96	70.5	70.5	1.93
Pond 3	3.73	1.46	39.2	82.1	1.93
Pond 1	12.7	9.5	74.8	74.8	1.93
Pond 4	3.18	0.91	28.6	82.1	1.93
Pond 3	Negative Reduction				1.93
3) Medicine Hat					
Winter (1962)					
Pond 1	4.98	3.56	71.8	71.8	2.14
Pond 2	1.40	0.59	42.0	83.5	2.14
Pond 3	0.82	0.06	7.3	84.7	2.14
Pond 4	0.76	0.23	30.8	89.5	2.14
4) Stettler					
Pond 1	2.78	1.79	64.1	64.1	5.94
Pond 2	0.94	0.26	27.7	74.1	6.20
5) Stony Plain					
Pond 1	20.0	13.10	65.4	65.4	1.18
Pond 2	6.9	3.05	44.2	80.6	1.18
Pond 3	1.35	0.44	32.6	86.9	3.30
6) Red Deer					
Pond 1	6.66	4.21	63.4	63.4	3.38
Pond 2	2.45	0.86	35.3	76.2	3.38
Pond 3	1.58	0.44	27.9	82.8	3.38
Pond 4	1.14	0	0	82.8	3.38
Pond 5	1.14	0.20	17.5	86.0	3.38
Pond 2	10.00	5.64	56.4	56.1	2.03
Pond 3	4.38	1.87	42.6	74.8	2.03
Pond 4	2.52	0.89	35.4	83.9	2.03
Pond 5	1.62	0	0	83.9	2.03
7) Three Hills					
Pond 1	8.65	2.23	25.8	25.8	2.24
Pond 2	6.40	4.35	67.8	76.0	2.24
Pond 3	2.06	0.45	21.8	81.3	2.24

* - lb/1000 ft^3/day

continued.....

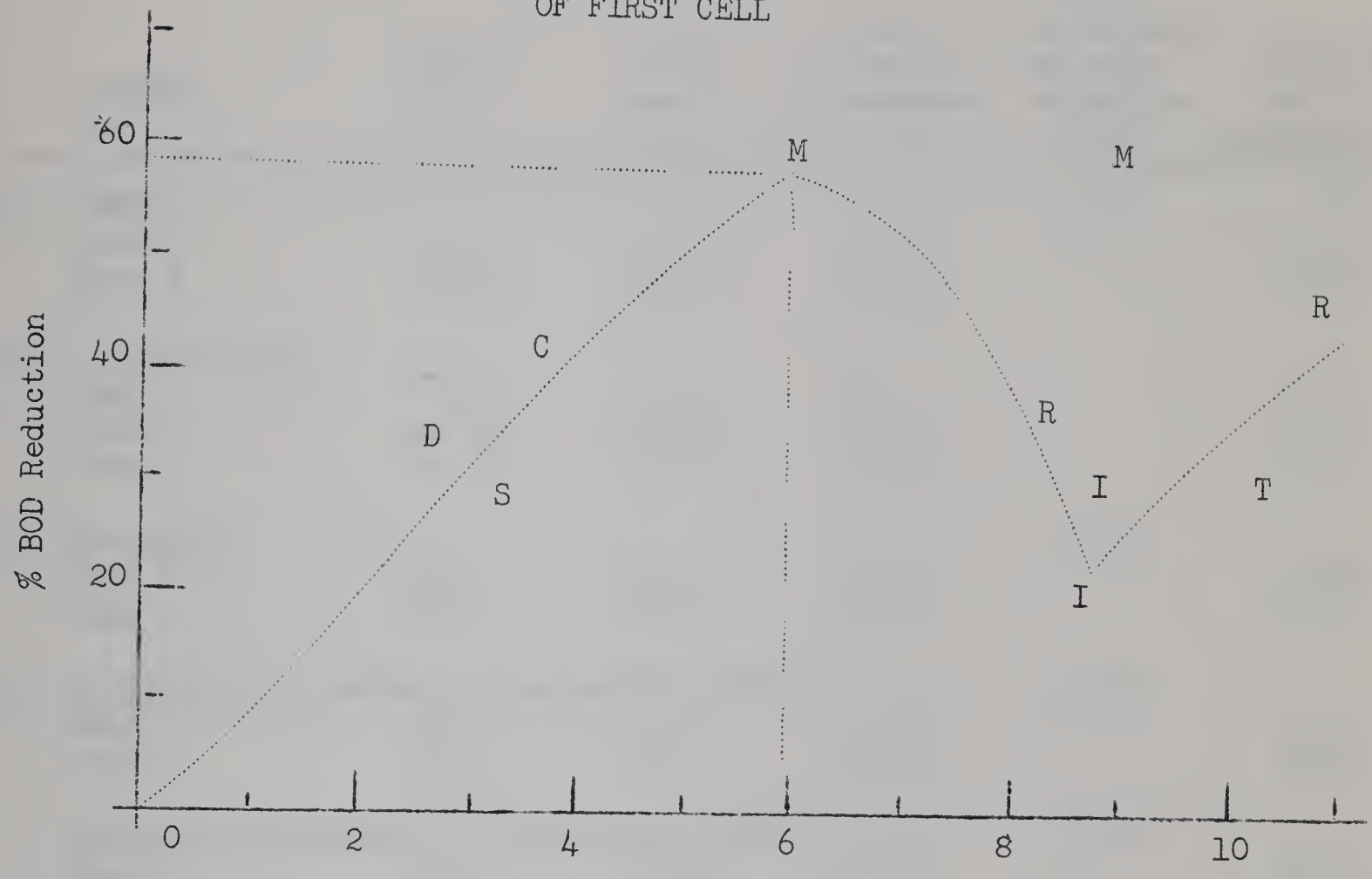
Table 19 (con't)

Location	Suspended Load Solids *	Suspended Solids Removed *	% Suspended Solids Reduction (As single units)	Total % Suspended Solids Removed	Detention Time - Days
7) Three Hills					
Pond 4	1.61	0.084	5.2	82.3	2.24
8) Wetaskiwin (NE)					
Pond 1	12.80	7.85	61.4	65.4	1.83
Pond 2	4.93	0.97	19.7	72.1	1.55
Pond 3	3.96	0.65	16.3	76.6	1.55
9) Drumheller					
Pond 1	1.97	1.26	63.8	63.8	6.75
Pond 2	0.67	0.07	10.4	67.6	7.15
Pond 3	0.68	0.18	26.5	76.0	6.30
Pond 4	0.49	0.15	31.4	83.5	6.50
10) Evansburg					
Pond 1	17.9	11.55	64.6	64.6	1.32
Pond 2	Negative Reduction				1.32

* - lb/1000 ft^3/day

Figure 23

SHORT DETENTION PONDS
"YEARLY BOD PERFORMANCE"
OF FIRST CELL



LEGEND

D - Drumheller
C - Camrose
I - Innisfail
M - Medicine Hat
S - Stettler
R - Red Deer
T - Three Hills

Note:

(a) Stony Plain BOD performance has not been plotted.
% BOD Reduction was 42.7
BOD Loading 17.7

(b) Evansburg BOD performance has not been plotted.
% BOD Reduction was 52.3
BOD Loading 58 lb/1000 ft^3/day

Table 20

YEARLY BOD PERFORMANCE - LONG DETENTION PONDS

Location	BOD Load *	BOD Removed *	% BOD Reduction (as separate units)	% BOD Reduction by short detention ponds	Total % BOD Reduction
1) Camrose				58.6	
Pond 1	23.7	11.4	48.1		75.4
Pond 2	13.4	3.8	28.4		82.5
2) Drayton Valley					
Pond 1	55.5	26.1	47		47.0
Pond 2	46.4	12.8	27.4		61.5
Pond 3	25.2	5.5	21.9		70.0
3) Evansburg				52.3	
Pond 1	317	151	47.8		70.0
Pond 2	61.6	47.3	76.5		93.0
4) Innisfail (preceded by 2 anaerobic ponds)				37.8	
Pond 1	98.1	35.6	36.2		60.3
Pond 2	13.1	8.56	65.4		86.3
Innisfail (preceded by 3 anaerobic ponds)				34.0	
Pond 1	104	35.0	33.5		56.1
Pond 2	14.5	5.78	40.0		73.6
5) Lacombe	25.7	12.1	47.1		47.1
6) Stettler				43.8	
Pond 1	32.2	12.9	40.0		66.1
Pond 2	16.7	6.36	38.1		79.0
7) Stony Plain				66.1	
Pond 1	7.46	3.81	50.8		83.2
8) Wetaskiwin (northeast system)				12.0	
Pond A	29.0	10.2	35.1		42.8
Pond B	33.6	26.8	80.0		88.6
Wetaskiwin (southeast system)					
Pond 1	248	163	65.6		65.6
Pond 3	34.5	8.5	24.7		74.4
Note: 2 ponds in series; spring operation.					
Pond 1	248	165	66.4		66.4
Pond 2	89.5	21.4	24.0		74.5
Pond 3	25.6	15.9	62.0		90.5
Note: 3 ponds in series; summer & fall operation.					

* - lb/acre/day

Table 21

WINTER BOD PERFORMANCE - LONG DETENTION PONDS

Location	BOD Load lb/acre/day	BOD Removed lb/acre/day	% BOD Reduction (as separate units)	% BOD Reduction by short detention ponds	Total % BOD Reduction
1) Camrose				52.8	
Pond 1	23.4	3.63	15.5		60.3
Pond 2	21.6	6.00	27.9		71.5
2) Drayton Valley					
Pond 1	55.5	15.6	28.2		28.2
Pond 3	46.8	13.5	28.8		48.8
Pond 1	55.5	16.2	29.1		29.1
Pond 2	62.0	10.3	16.5		40.8
Pond 3	38.6	8.28	21.4		53.5
3) Evansburg				40.2	
Pond 1	403	132	32.7		50.8
Pond 2	101	92.5	91.6		96.0
4) Innisfail (preceded by 2 anaerobic ponds)				40.0	
Pond 1	94.6	10.85	11.5		47.0
Pond 2	17.5	11.7	66.9		82.4
Innisfail (preceded by 3 anaerobic ponds)				30.1	
Pond 1	110.5	15.1	13.7		39.7
Pond 2	19.9	7.54	38.0		62.5
5) Lacombe	25.7	7.74	30.1		30.1
6) Stettler				37.3	
Pond 1	35.8	7.93	22.0		51.1
Pond 2	24.2	10.8	44.6		73.0
7) Stony Plain				66.1	
Pond 1	7.46	0.87	11.6		70.0
8) Wetaskiwin (southeast system)					
Pond 1	82.8	15.9	19.3		19.3
Pond 2	89.4	21.4	24.1		24.1
Pond 3	33.6	7.0	20.9		20.9

Ponds operated in parallel.

Table 22

SUMMER BOD PERFORMANCE - LONG DETENTION PONDS

Location	BOD Load lb/acre/day	BOD Removed lb/acre/day	% BOD Reduction (as separate units)	% BOD Reduction (by short detention ponds)	Total % BOD Reduction
1) Camrose				72.8	
Pond 1	13.5	11.6	85.5		96.3
Pond 2	2.05	1.03	50		98.1
2) Drayton Valley					
Pond 1	55.5	39.1	70.5		70.5
Pond 2	26.9	13.5	52.3		86.0
Pond 3	9.2	4.29	46.7		92.5
3) Evansburg				54.0	
Pond 1	26.9	134	50		75.4
Pond 2	50.3	32.1	64		90.8
4) Innisfail (preceded by 2 anaerobic ponds)				43.9	
Pond 1	88.6	64.5	72.8		84.6
Pond 2	5.05	3.4	67.5		95.0
Innisfail (preceded by 3 anaerobic ponds)				44.6	
Pond 1	87.6	62.3	71		83.9
Pond 2	5.3	1.76	33.3		89.1
5) Lacombe	25.7	23.6	92.0		92.0
6) Stettler				63.6	
Pond 1	20.8	16.8	80.5		93.0
Pond 2	3.49	1.27	36.3		95.5
7) Stony Plain				73.6	
Pond 1	5.8	4.53	78.1		94.2

APPENDIX C

RESULTS AND SKETCHES OF SLUDGE AND TEMPERATURE SURVEYS

	Page
Accumulation and Reduction Rate	C-1
Sludge Analyses	C-2
Sludge Temperature Red Deer Pond No. 2	C-5
Sketches of Sludge Distribution	
- Camrose	C-6
- Medicine Hat	C-7
- Stettler	C-8
- Red Deer	C-9
Temperature Survey	
- Red Deer	C-15
- Medicine Hat	C-18

Table 23

POND INLET - SHORT DETENTION PONDS

Location	Depth of Pond (ft)	Distance of Inlet Above Pond Bottom (ft)	Length of Pipe Extending Into Pond (ft)	Area of Pond (acres)
Camrose	10	5	1.5	1.1
Medicine Hat	10	3	100.0	2.2
Stettler	10	7	2.0	0.57
Red Deer	10	9	5.0	1.18

Table 24

THE ACCUMULATION RATE OF SLUDGE

Location	Survey Period or Time of Survey	Accumulation Rate ft^3/day	ft^3/day/1000 persons
Camrose	November 2, 1962	72	10.1
	Nov.2/62 to August 14/63	73	9.48
Medicine Hat	October 15/62	103	4.22
Stettler	July 18/63	33.4	8.75
Red Deer Pond No. 1	June 1962	284.0	13.5
	June 1962 - October 1962	66.5	3.15
	October 1962 - June 1963	216	9.40
	June 1962 - June 1963	166	7.21
Red Deer* Pond No. 2	July 1964	54.6	2.38

* Pond No. 1 was by-passed during this period.

Table 25

REDUCTION RATE OF SLUDGE IN POND NO. 1 AT RED DEER

Noted this pond was by-passed: -

Date of Survey	Reduction Rate ft^3/day	in/day
July 1963 - Sept. 1963	1360	0.316
Sept. 1963 - July 1964	58.1	0.0135
July 1963 - July 1964	273	0.063

Table 26

SLUDGE ANALYSIS

For locations of sludge sampling ponds see figures 24 to 31

(A) Camrose Primary Pond No. 1:-

Date	Location	pH	Temp. oC	% Solids	% Volatile Matter	Volatile Acids ppm as Acetic Acid	Appearance
Nov. 2/62	E2	6.2	13	14.1	32.2	1650	Offensive odor, thick black material
	D3	6.5	12	11.4	39.0	818	Fine dark material. Good drainability
	C4	6.8	13	5.5	12.9	53	Very little odor, black, homogenous in texture.
Aug. 14/62	D2	6.25	15	16.1	30.3		Homogenous in texture, black tarry odor.
	C3	6.45	15	15.3	32.0		Homogenous, black tarry odor.
	E1	4.90	12	-	-		Individual particles, brown-black putrid odor.
(B) Stettler Pond No. 1:-							
July 18/62	X	6.6	18	12.1	31.5		Black, tarry odor, Homogenous.
	Y	6.4	19	27.2	20.8		Black, tarry odor, well-digested.

continued .....

Table 26 - Cont'd.

(C) Medicine Hat Pond No. 1

Date	Location	pH	Temp. °C	% Total Solids	% Volatile Matter	Volatile Acids, ppm.	Appearance
Oct. 15/62	1+20	4.9		10.0	65.0	1510	Black, thick, slimy
	1+70	5.2		10.4	84.0	-	Grey, thick & granular, very strong odor
	2+20	5.8		9.0	57.5	775	Fine material, black
	2+70	5.8		7.0	56.7	935	Fine material, black
	3+20	6.0		6.4	62.5	244	Fine material, black
	3+20*	6.2		9.0	62.3	-	Good drain-ability
	3+20*	6.1		6.2	61.0	-	
June 7/63	0+70	5.95	19	8.1	55.0	95	Black, slight odor, homogen-ous in texture
	1+20	5.70	19	14.3	42.3	180	Very fine dark slurry; tarry odor
	1+70	4.60	19	-			Coarse, foul odor, brown
	2+20	4.75	15	11.9	93.1	1791	Coarse to fine material; strong odor
	2+70	4.90	17	9.2	62.1	1739	Fine black material, tarry odor
	3+20	5.05	17	8.7	57.0	1320	Coarse to fine, tarry odor
Mar. 3/64	C	6.3	7.4	6.7	50.5		Tarry odor, well digested
	D	7.1	7.6	7.7	45.2		Black

Note: All locations are along centerline except for * - indicates left and right of centerline.

continued .....

Table 26 (con't)

(D) Red Deer Pond No. 1:-

Date	Location	pH	Temp. °C	% Solids	% Volatile Matter	Appearance
Oct.23/62	L	5.5	9	10.1	62.5	Granular, grey-black very strong odor.
	M	5.7	9	20.6	30.4	Fine black material, very thick.
	N	5.8	9	17.0	40.0	Fine black material, slight odor.
June 19/63	L	5.1	13			Putrid, very strong odor, individual particles.
	M	5.6	13			Black, tarry odor, fine material.
	N	5.8	13			Black, tarry odor, mainly liquid.
Sept.19/63*	L	5.1	13	27.9	50.0	Individual particles, putrid odor, brown-black.
	M	5.5	13	15.8	76.0	Putrid odor, grey
	N	5.7	13	25.5	48.4	Tarry odor, homogenous, black.
July 8/64*	0+30 @ 3'	5.4		7.6	72.1	Offensive odor, granular material.
	(L) 0+50 @ 8.5	6.7		14.9	49.6	Tarry odor, very thick material.
	N	6.6		15.2	41.8	Tarry odor, very thick material, well-digested.

* - By-pass period.

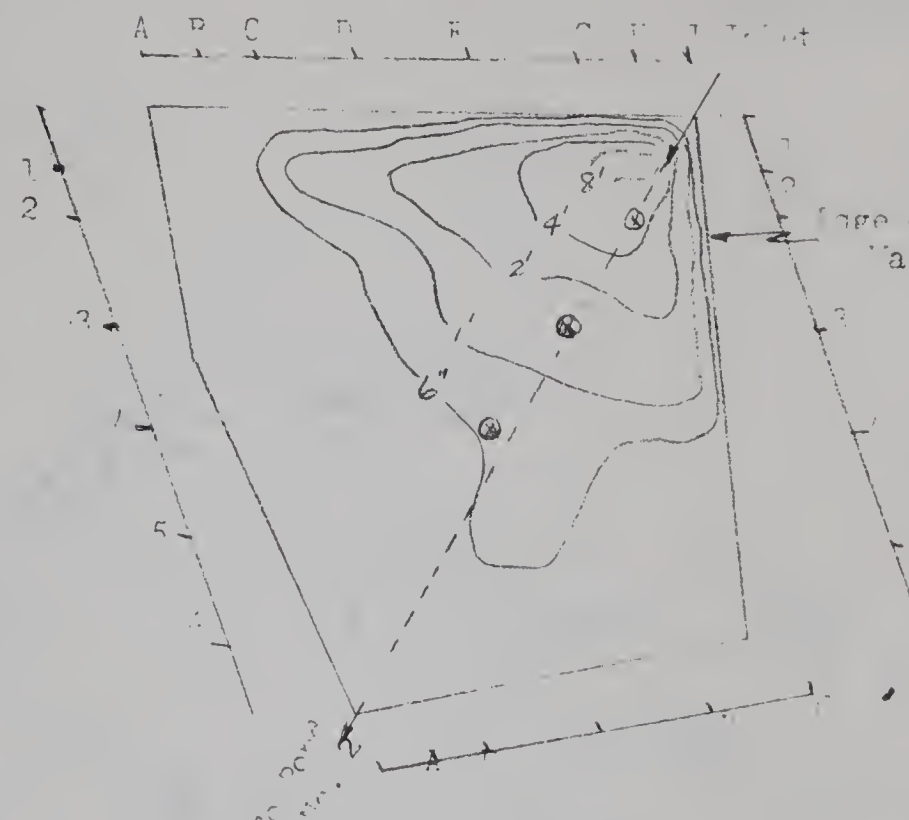
Table 27

SLUDGE TEMPERATURE IN POND #2 AT RED DEER

Date	Temperature °C.	
March 2/64	11	Raw Sewage Temp. - 14°C
11 at 9 a.m.	11.5	
11 at 4 p.m.	12.5	
March 12 at 7 a.m.	11.5	
12	11.5	
17	11.5	
19	11	
25	10.5	
26	11	
31	11.5	
April 2	12.5	
8	14.5	
9	12	
16	12	
22	12.5	
23	12.0	
May 6	12.2	
6 at 5 p.m.	12.7	
15 at 9:30 a.m.	12.5	
20 at 11 a.m.	17.8	
June 3 at 10 a.m.	18.9	
17 at 11 a.m.	18	
July 2 at 11 a.m.	20.5	
7 at 12 Noon	21	Surface Temp. - 24°C.

The above temperatures were measured by a long distance temperature indicator. The probe of the indicator was installed about 75 feet from the raw sewage inlet and in about two feet of sludge.

"SLUDGE SURVEY"
CAMROSE PRIMARY NO. 1 POND



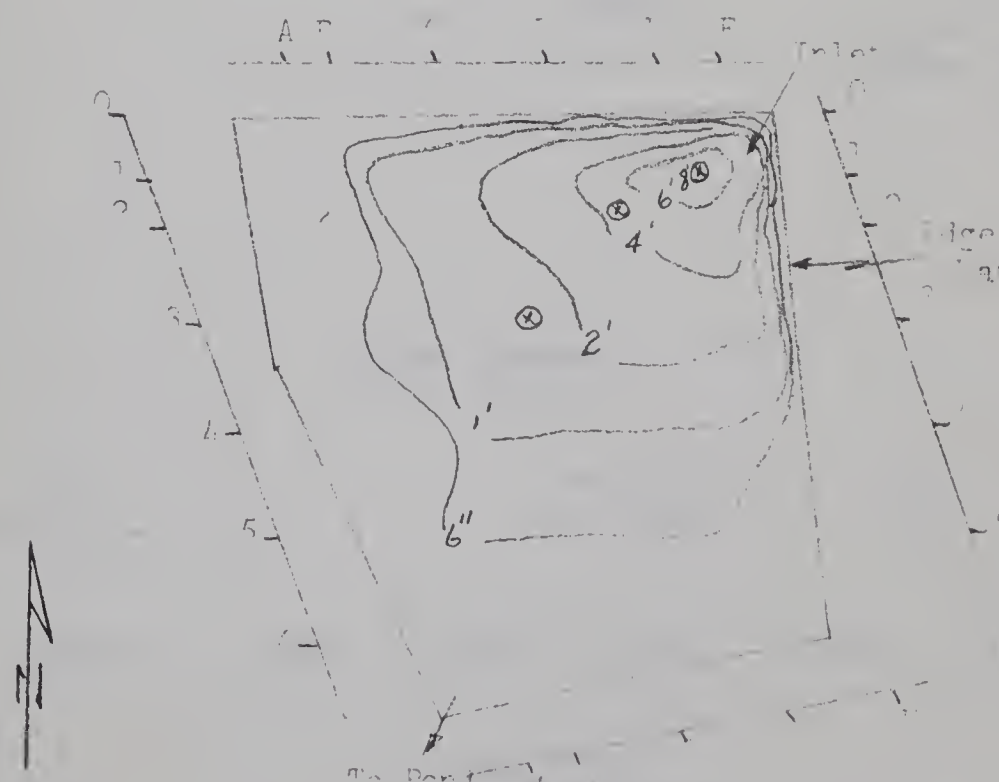
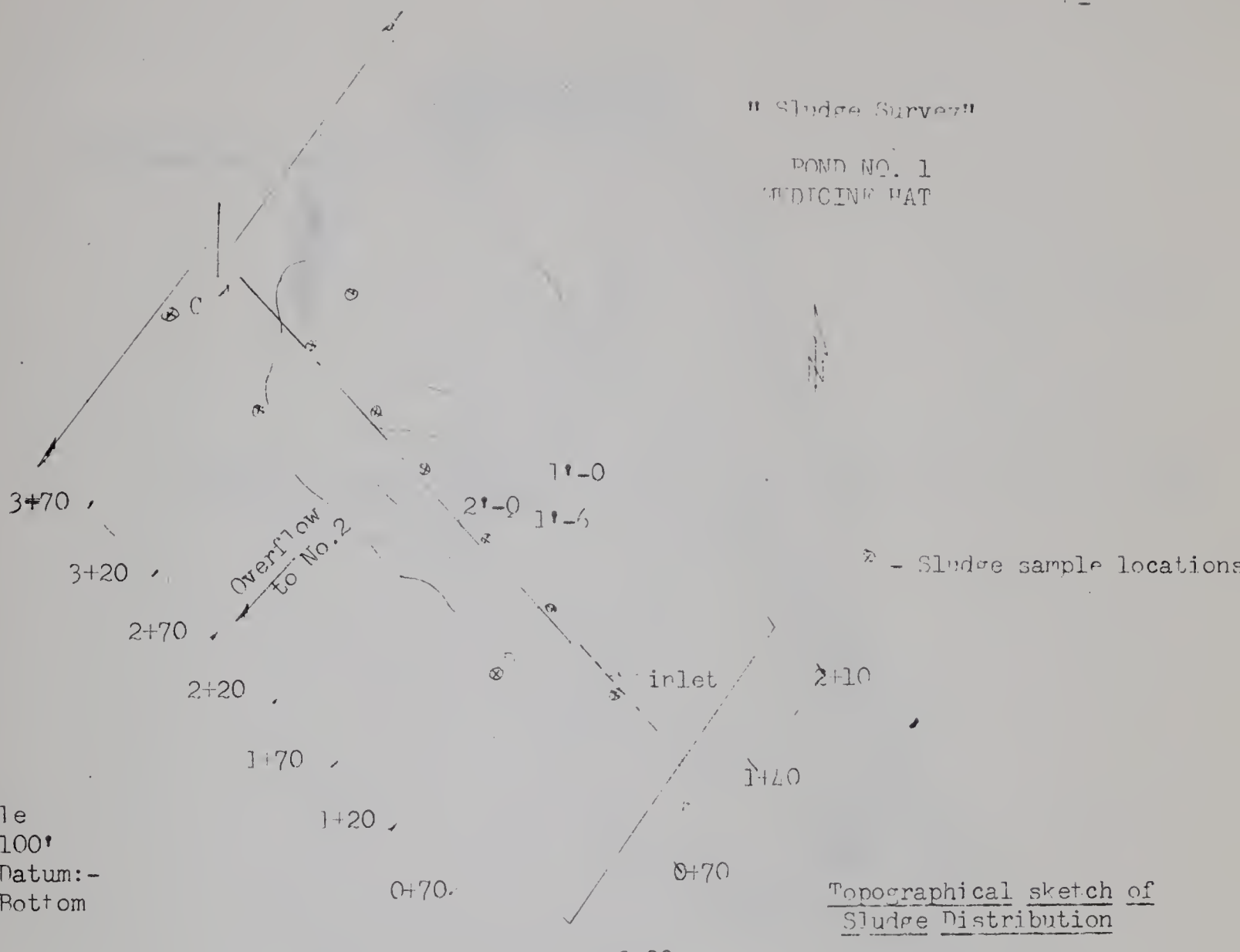


Figure 24

" Sludge Survey"

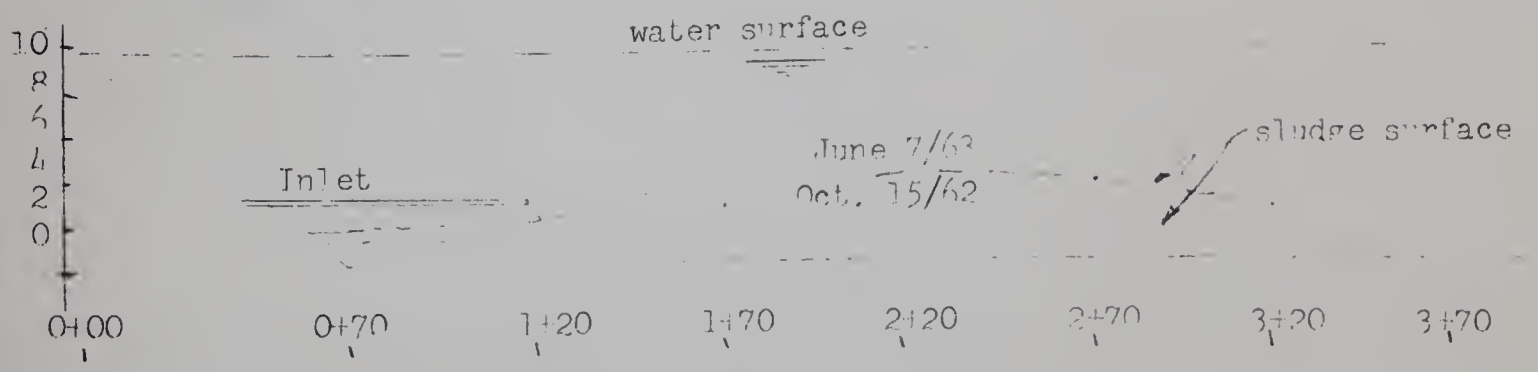
POND NO. 1
MEDICINE HAT



Scale
1" = 100'
Zero Datum:-
Pond Bottom

Topographical sketch of Sludge Distribution

As on Oct. 15/62
Note: Location of Inlet Re-located in Nov./63 See Figure 14 .

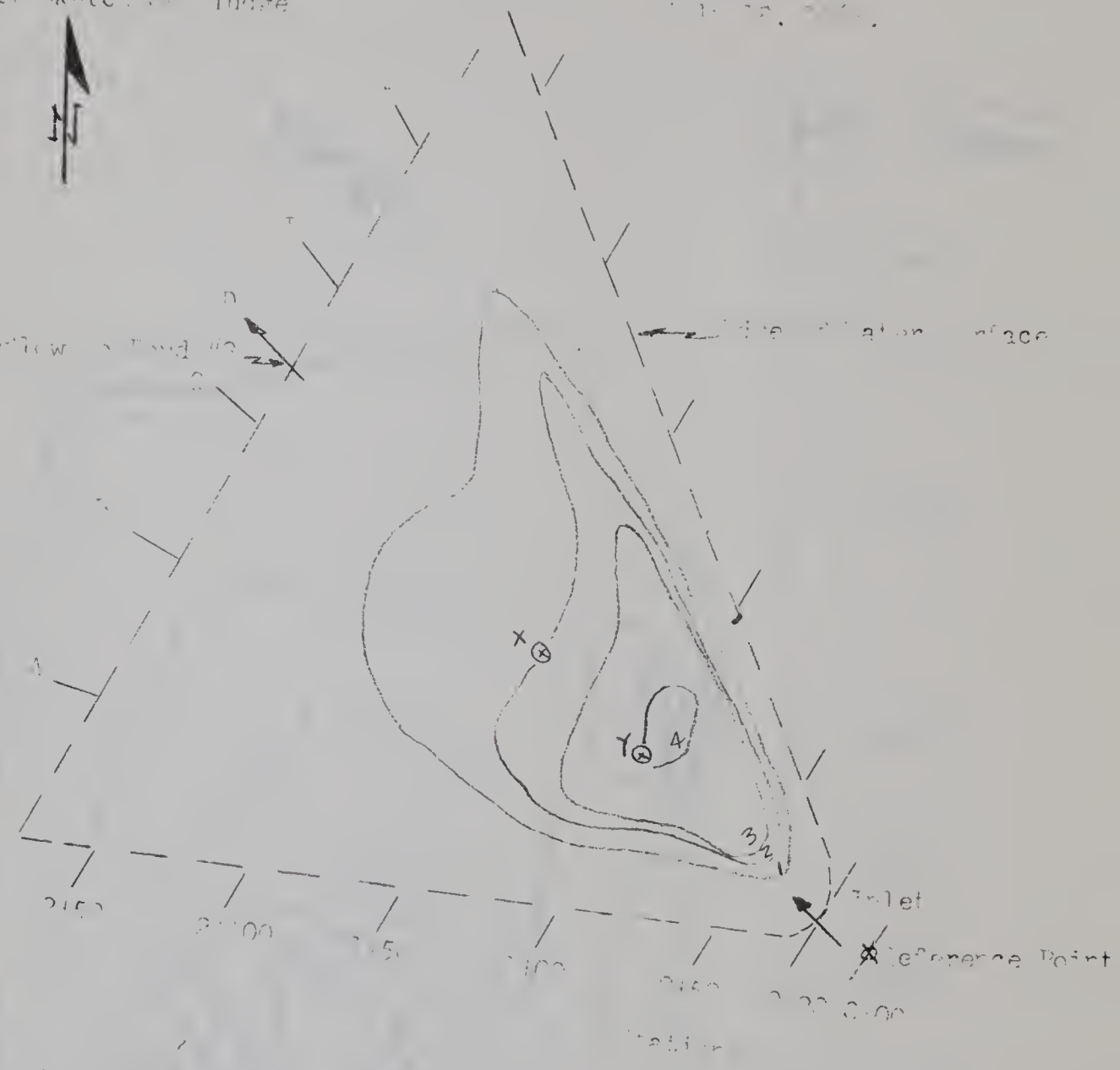


Section X-X
Sludge Profile

Scale:
Horiztontal 1" = 40'
Vertical 1" = 10'

Figure 25

Topographical Sketch of Sludge

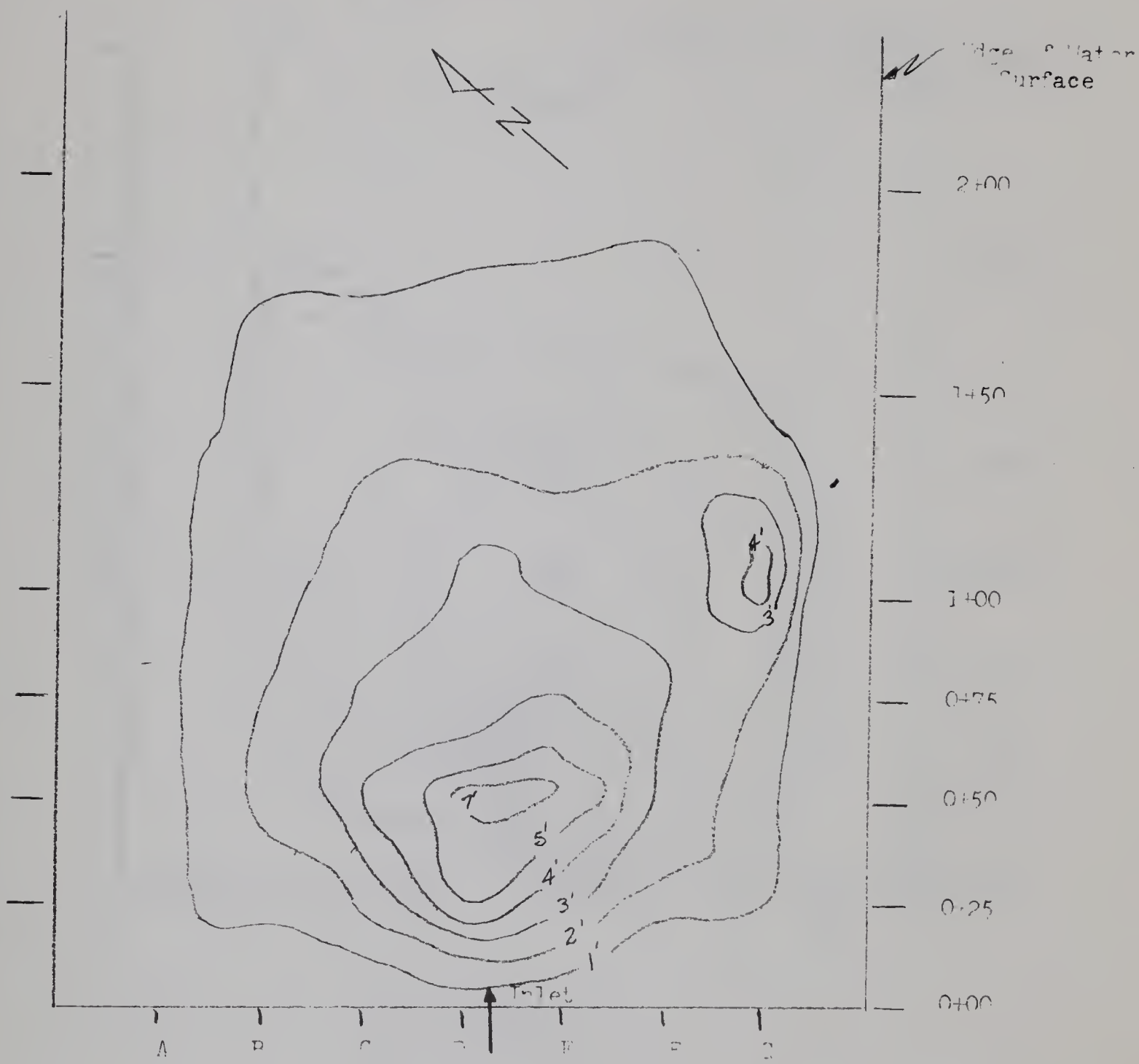


⊗ Sludge Sample Location

Scale 1" = 40'

Zero Datum - Bottom of Pond

"SLUDGE SURVEY"
RED DYER POND NO. 1



Topographical Sketch
of Sludge

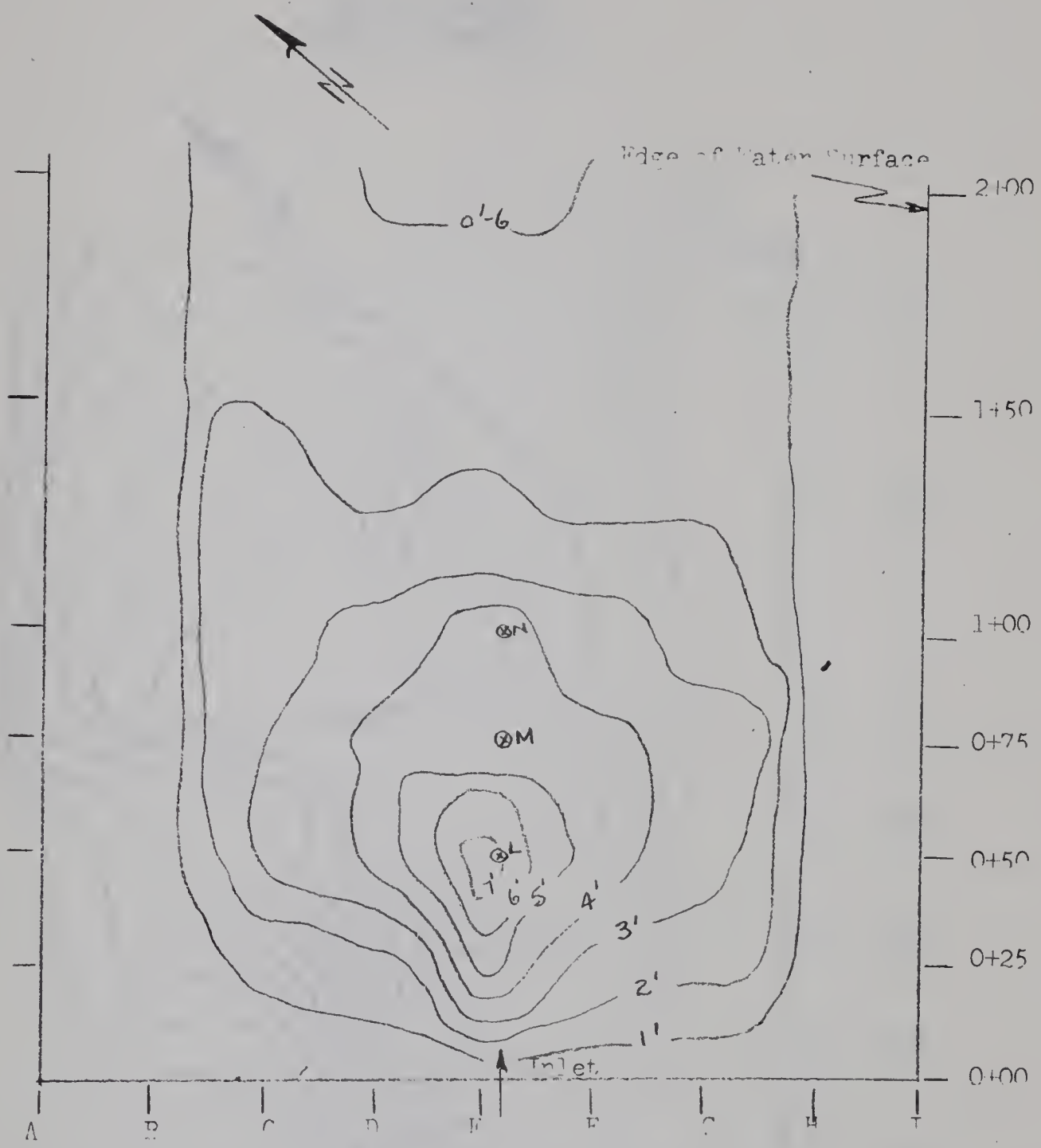
Scale 1" = 40'.
⊗ - Sludge Sample Location
Zero Datum - Bottom of Pond

June 20, 1972

Figure 27

"SLUDGE SURVEY"
RED DEER POND NO. 1

C-10



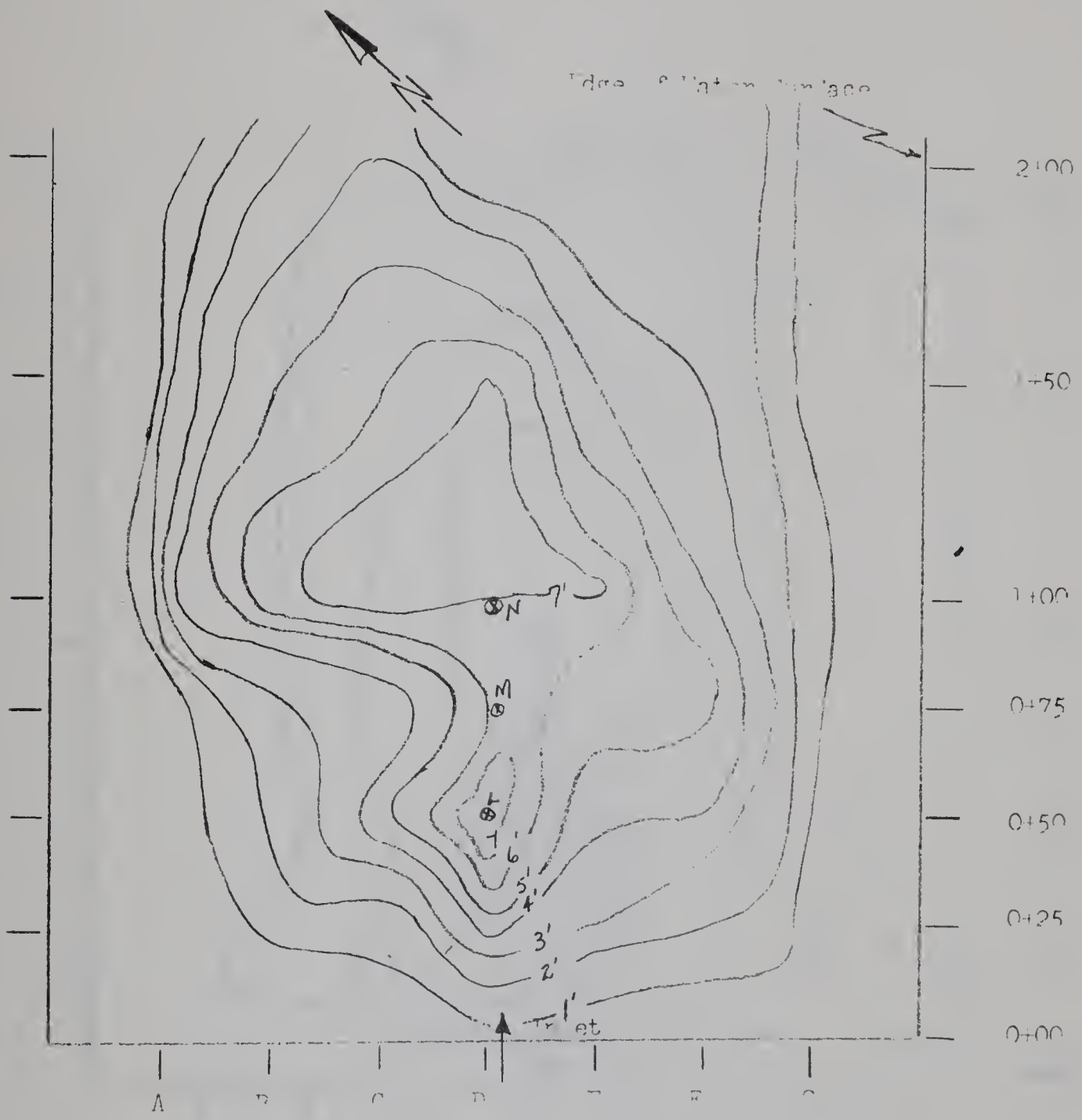
Topographical Sketch
of Sludge

Scale 1" = 40'
⊗ - Sludge Sample Location
Zero Datum - Bottom of Pond

October 23, 1962

Figure 2e

"SLUDGE SURVEY"
RED DEER POND NO. 1



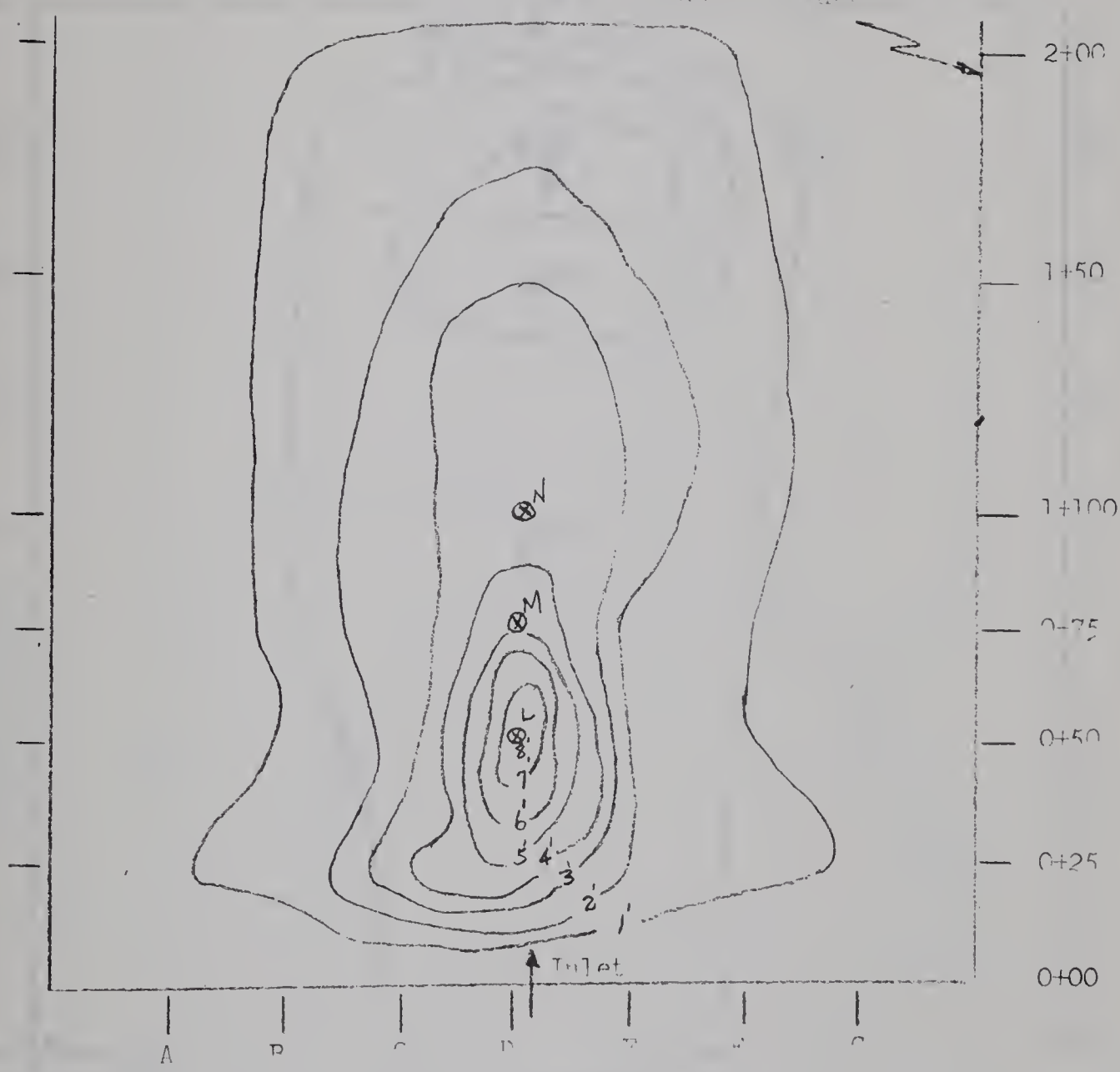
Topographical Sketch
of Sludge

Scale 1" = 10'
⊗ - Sludge Sample Location
Zero datum - Bottom of Pond

June 15, 1973

Figure 2

"[illegible] SURVEY"
RED DEER POND NO. [illegible]



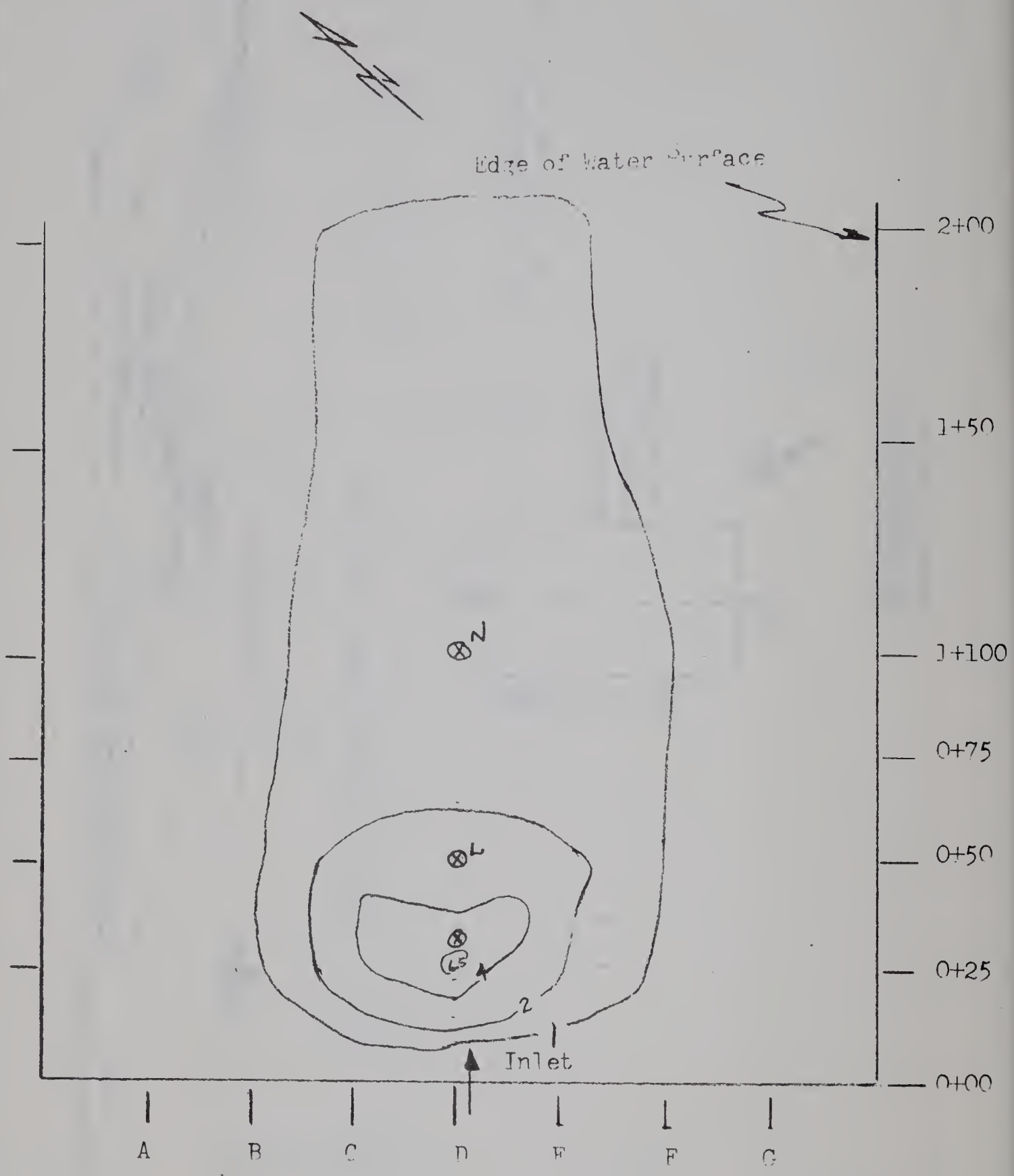
Topographical Sketch
of Ridge

Scale 1" = 4'
⊗ - Sludge Sample Location
Reference datum - Bottom of Pond

September [illegible], 1962

Figure 30

"SLUDGE SURVEY"
RED DEER POND NO. 1



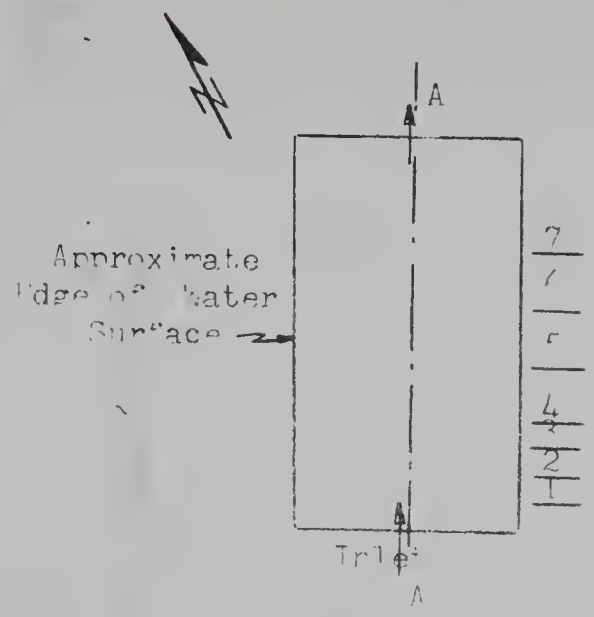
Topographical Sketch
of Sludge

Scale 1" = 40'
⊗ - Sludge Sample Location
Zero datum - Bottom of Pond

July 8, 1964

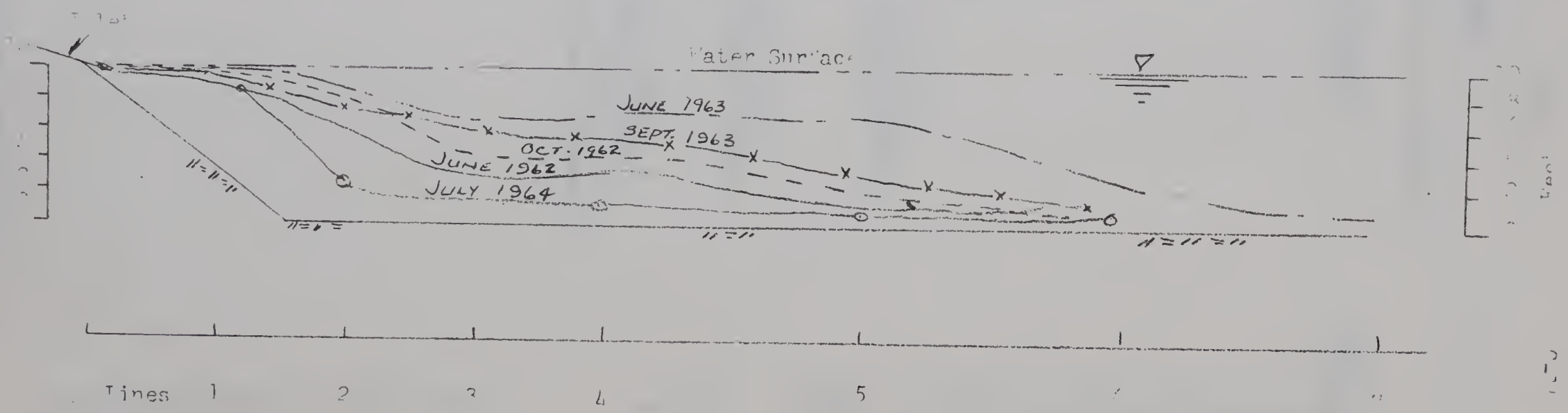
Figure 31

"SLUDGE SURVEY"
RED DEER POND NO. 1



Scale: Vertical 1" = 10'
Horizontal 1" = 30'

Plan View of Pond - Scale 1" = 200'



Profiles of Sludge Surface - Line A-A

Figure 32

Table 28

Temperature Survey - Feb. 13, 1963.

RED DEER SEWAGE PONDS

Temperature at Locations and Depths as Indicated

	Location*	Water Depth (Feet)	Temperature °C
Pond One	A	Surface	11
		2.5	9
		6	9
		9	9
	B	Surface	12
		2.5	9
		6	9
		9	9
	C	Surface	12
		2.5	9
		6	9
		9	9
	D	Surface	13
		3.5	9
		6.5 (just below sludge surface)	9.5
	E	Surface	12.5
		1.5	11.5
		4	9
		7 (just below sludge surface)	
	F	Surface	12
		3.5	9
		6.5 (just below sludge surface)	9

Effluent temperature 10 degrees centigrade.

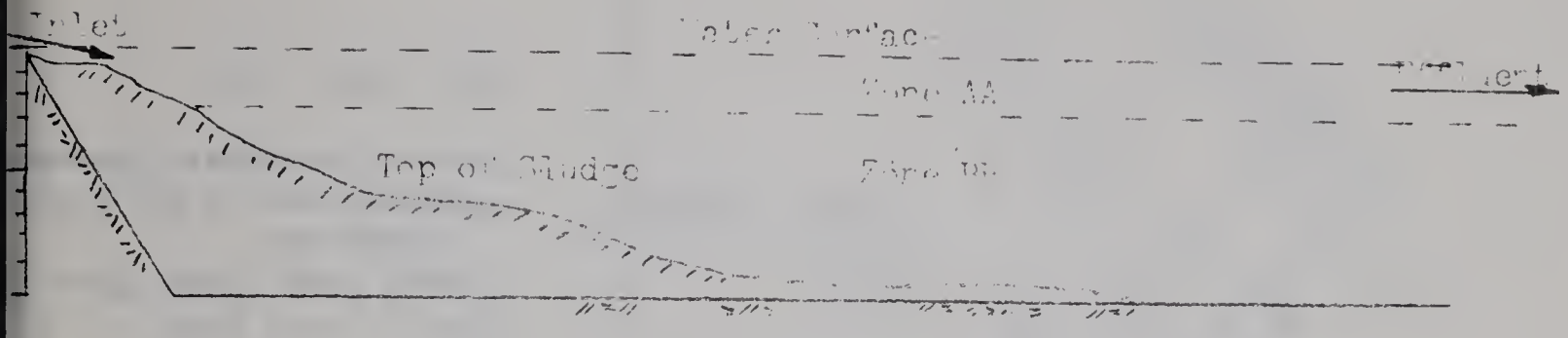
Pond Two	A	Surface	9
		2	8
		5.5	7
		8.5	7
	B	Surface	9
		2	7
		5.5	7
		8.5	7
	C	Surface	9
		1.5	8
		5	7
		8	7
	D	Surface	7
		2.5	7
		6	7
		9	7

Effluent temperature - 6 degrees centigrade.

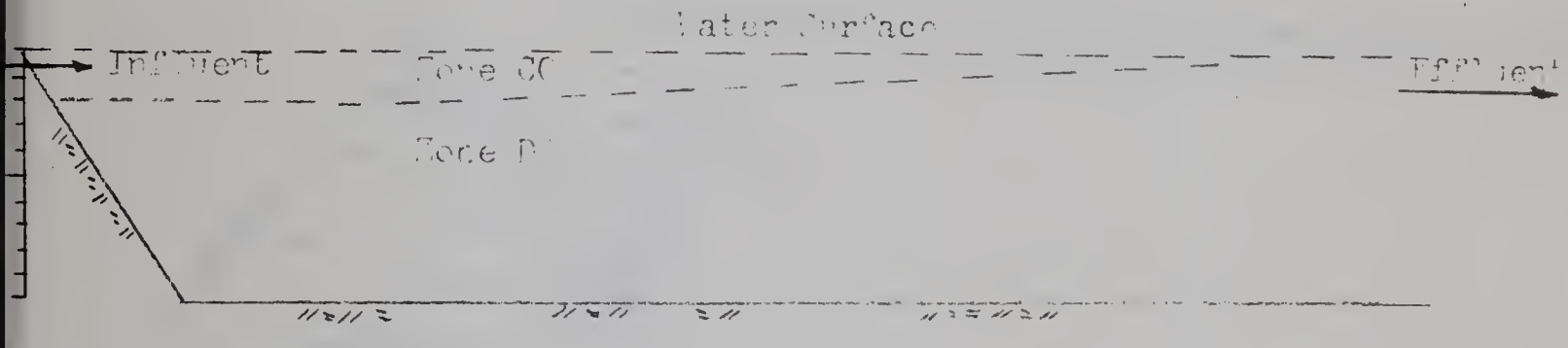
continued.....

Table 28 (con't)

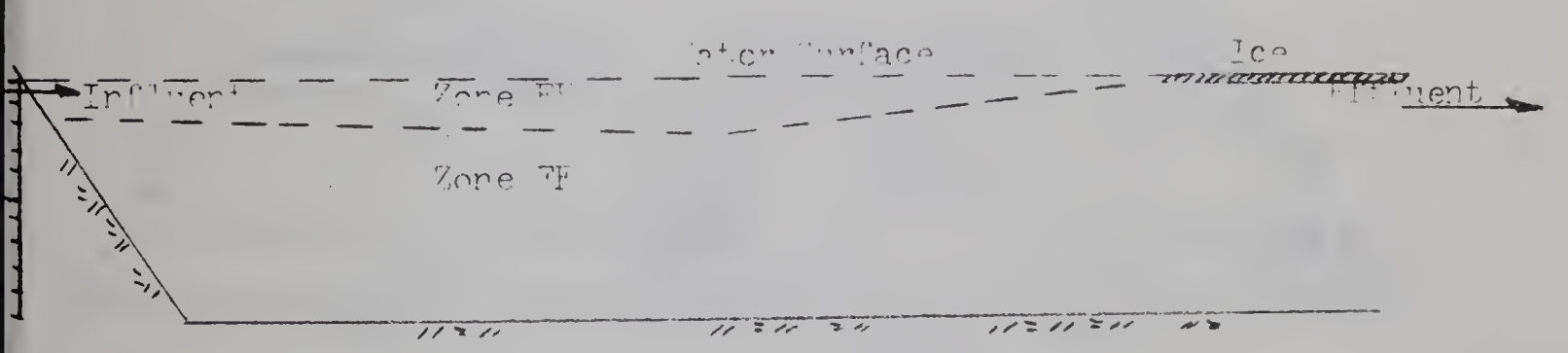
Pond Three	Location*	Water Depth (Feet)	Temperature °C
	A	Surface	5
		2	5
		5.5	5
		8.5	4.5
	B	Surface	6
		2	6
		5.5	5
		8.5	5
	C	Surface	6
		2	5
		5.5	5
		8.5	4.5



POND 1 - Profile



POND 2 - Profile



POND 3 - Profile

Temperature Ranges In Centigrade

Raw Sewage	15
Zone AA	9 to 13
Zone BB	Constant at 9
Zone CC	7 to 9
Zone DD	Constant at 7
Zone EE	5 to 6
Zone FF	4.5 to 5

Note: Profiles are in direction of flow.

Scale: Vert. 1" = 10'
Horiz. 1" = 60'

Date: February 13, 1963

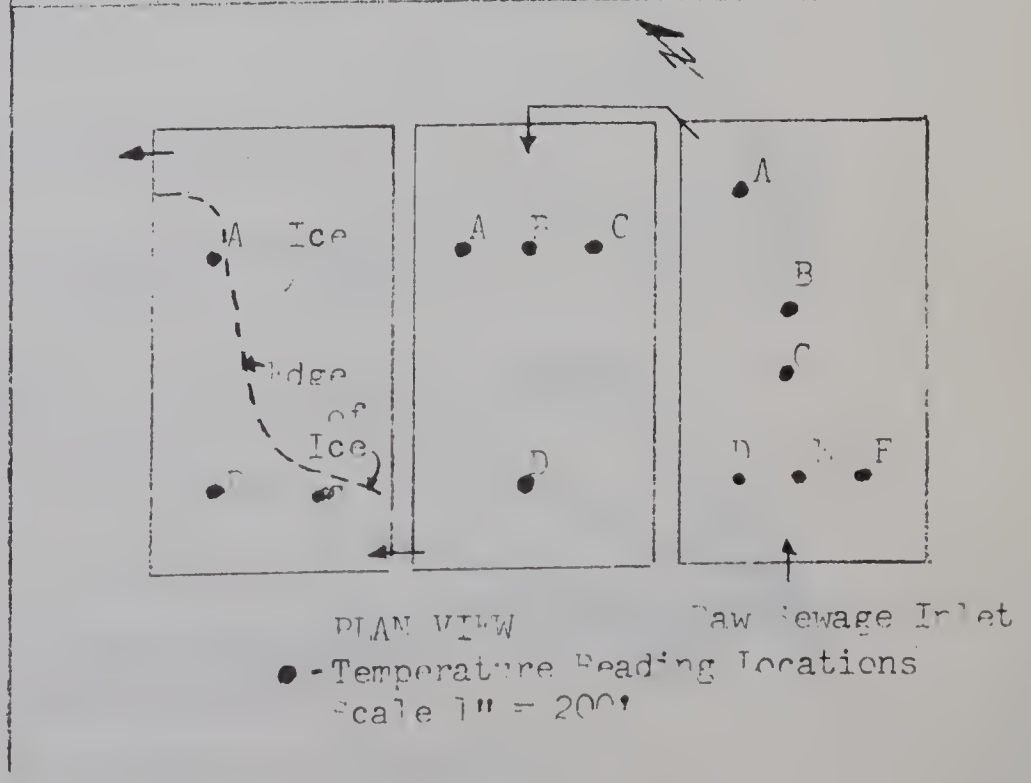
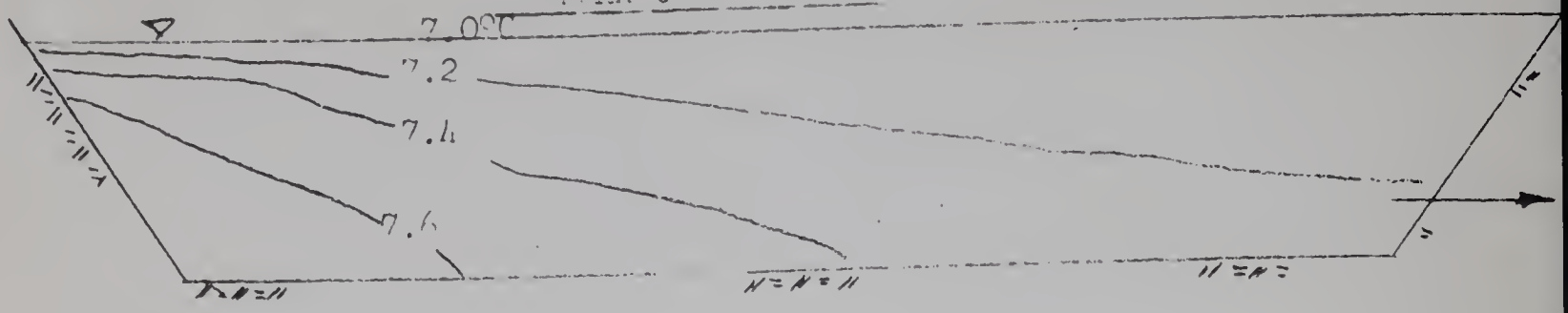


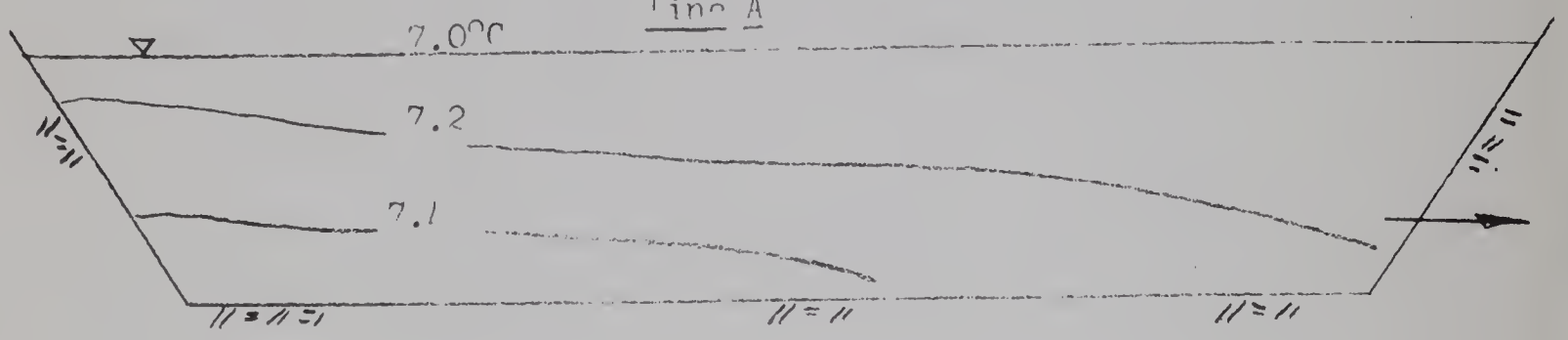
Figure 33

Temperatures - Medicine Hat Sewage Pond 1.

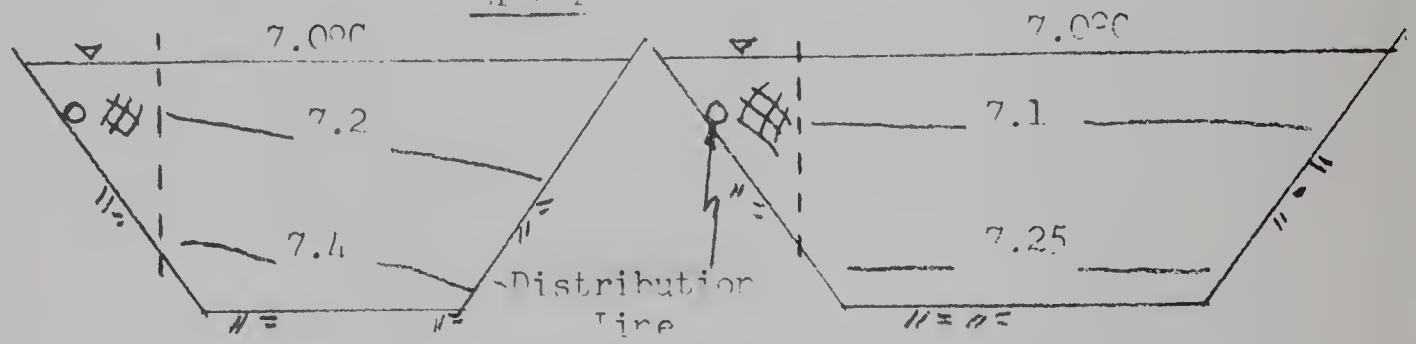
TEMPERATURE PROFILES



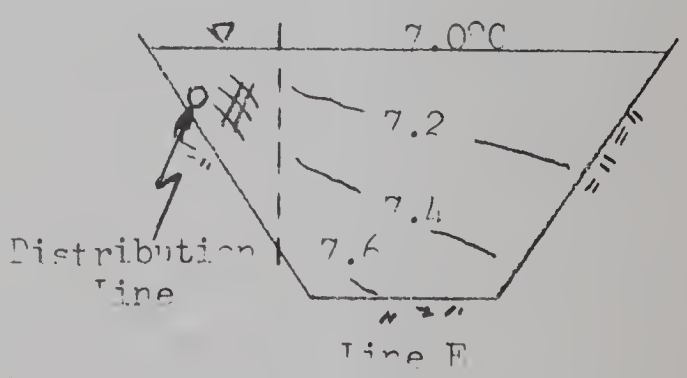
Line A



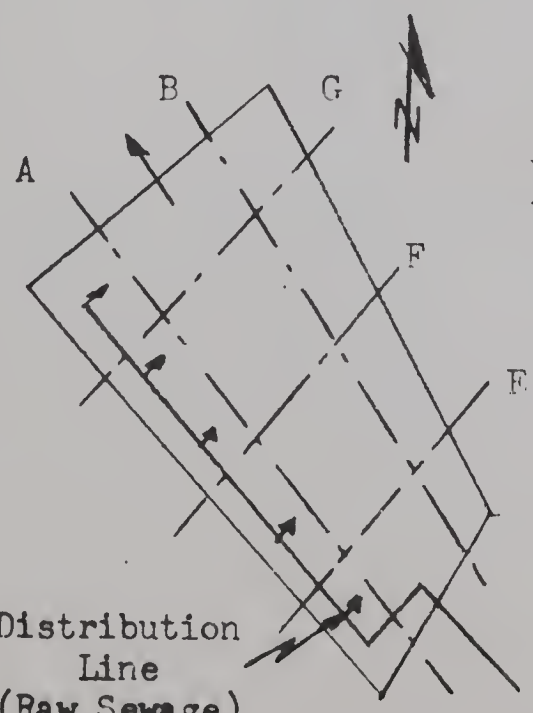
Line B



Line F Line G



Line E



Plan
Pond 1
Scale 1"=300'

Scale:

Vert. - 1" = 10'
Hori. - 1" = 100'
Shaded Area Shown Thus
Indicates:
Temperatures in This Zon
Due to Raw Sewage Tempera

Date: Mar. 3/64

Figure 34

- APPENDIX D -

Table 29

WATER SUPPLY ANALYSIS

Location	Camrose	Drayton Valley	Drumheller	Evansburg	Innisfail
Total Solids	322	924	406	368	378
Ignition Loss	100	38	124	130	96
Hardness	175	35	320	130	275
Sulphates	39	216	103	24	43
Chlorides	14	7	7	Nil	Nil
Alkalinity	205	480	155	315	190
Nature of Alkalinity	Bicarbonate of lime & magnesium	Bicarbonate of soda, lime & magnesium	Bicarbonate of lime & magnesium	Bicarbonate of soda, lime & magnesium	Bicarbonate of lime & magnesium
Nitrites	trace	1.6	trace	Nil	trace
Nitrates	trace	trace	trace	Nil	trace
Iron	Nil	0.2	0.2	0.1	trace

Analyses in ppm

Table 29 (con't)

Location	Lacombe	Medicine Hat	Red Deer	Stettler	Stony Plain	Wetaskiwin
Total Solids	572	286	210		856	744
Ignition Loss	144	84	140		322	80
Hardness	15	210	105	18	445	44
Sulphates	trace	50	13	813	205	125
Chlorides	11	4	Nil	5	5	77
Alkalinity	455	190	80	700	290	459
Nature of Alkalinity	Bicarbonate of soda	Bicarbonate of lime & magnesium	Bicarbonate of lime & magnesium		Bicarbonate of lime & magnesium	Bicarbonate of soda, Lime & magnesium
Nitrites	Nil	Nil	Nil	Nil	Nil	Nil
Nitrates	Nil	Nil	Nil	Nil	Nil	Nil
Iron	Nil	1.0	Nil	0.05	0.4	0.4

Analyses in ppm

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